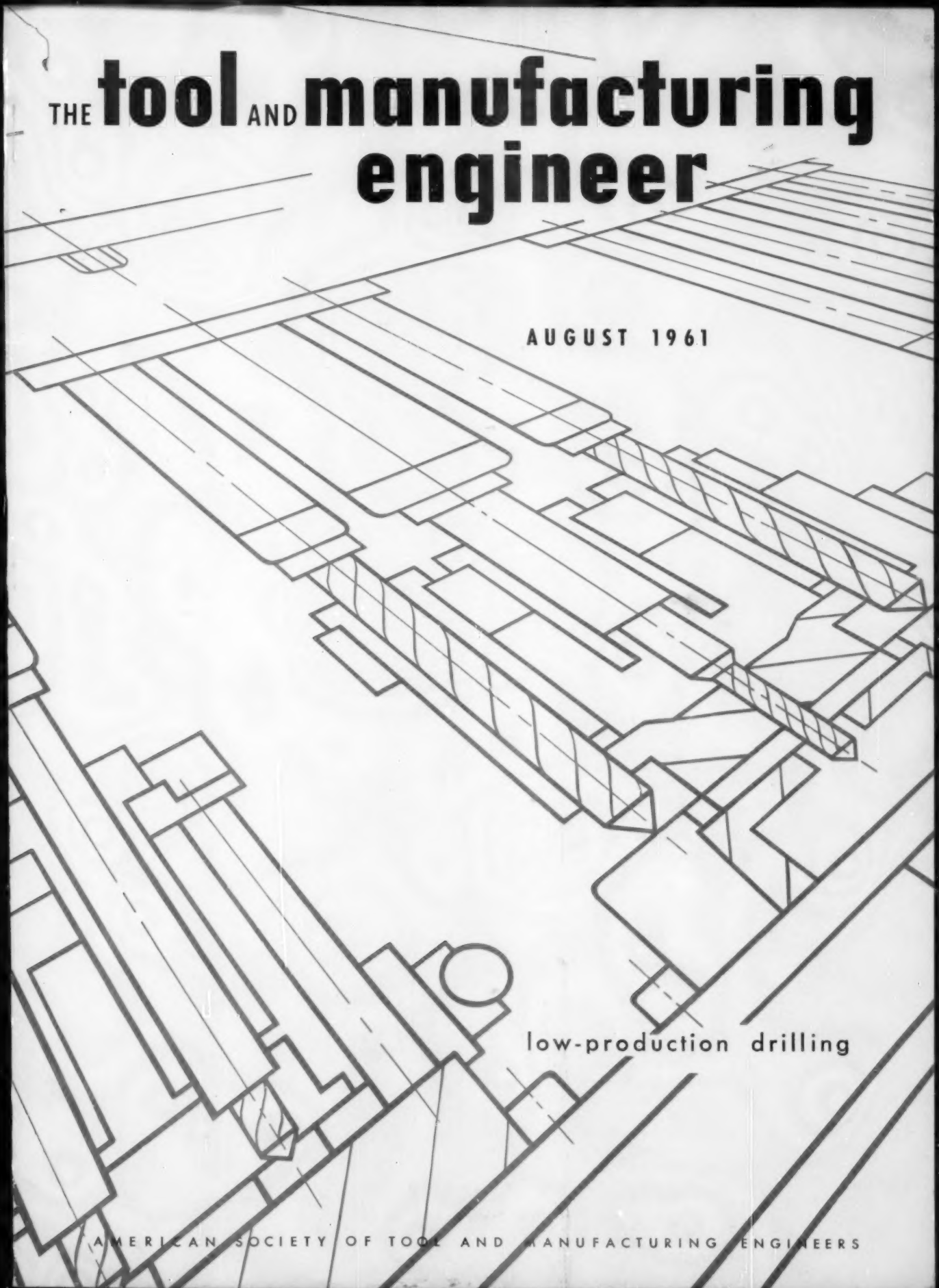
THE tool AND manufacturing engineer

AUGUST 1961



low-production drilling

AMERICAN SOCIETY OF TOOL AND MANUFACTURING ENGINEERS

EFFECTIVE COOLING...

How to Avoid Barrel-Shape Bores

by Dr. Robert Hahn
Chief Research Engineer
The Heald Machine Company

One of the oldest problems in high-precision internal plunge grinding is that of the unwanted barrel-shaped hole. For some time the cause of this seemingly unavoidable defect was not well understood. How could a perfectly straight wheel, perfectly aligned with the bore, plunge grind a barrel-shape hole?

Recent investigations in this area, as part of our continuing quality improvement program, have isolated the cause and pointed the way to some fairly simple solutions to the problem.

The culprit is *heat*. At the area of contact between work and wheel, the generated heat is more quickly dissipated at the ends of the bore than at the center. This temperature relationship is shown in Fig. 1, with surface temperatures reaching maximum value at the center of the bore. Maximum temperature means maximum thermal expansion—expansion that forces more metal into the wheel at the center of the bore than at the ends. With this unequal stock removal, the bore assumes a barrel shape on cooling. These relationships hold true for plunge grinding, and also, but to a lesser extent, for some cases in traverse grinding where limiting factors require a short stroke.

To reduce the barrel shape, it is necessary to level out the temperature curve—by reducing the amount of heat generated and by providing more effective cooling.

The contact area between wheel and work can be considered as a moving heat source that travels around the bore at a rate equal to the workhead speed. The faster this heat source travels, the less the heat will penetrate into the metal. Hence higher work speeds will reduce local heating. And since the heat generated is a function of contact pressure and surface feet per minute, lighter feeds and slower wheel speeds in such cases also help to reduce the thermal distortion.

Water-base coolants, copiously applied, have also proved an effective remedy. As shown in Fig. 2, the coolant flow should maintain a full "reservoir" at the bottom of the bore, as well as between the wheel and work. The coolant flow at the bottom of the bore quenches the metal immediately after the ground surface passes the wheel and assures maximum cooling effect before this point again contacts the wheel.

In practically all cases, a judicious combination of these factors—faster work speeds, slower wheel speed, lighter feeding pressure and improved cooling—will reduce the barrel-shape of a bore to negligible values. This study is typical of the continuing research being conducted at Heald to help refine the art of modern metalworking. Your nearest Heald representative will be glad to help you solve your particular grinding or boring problems.

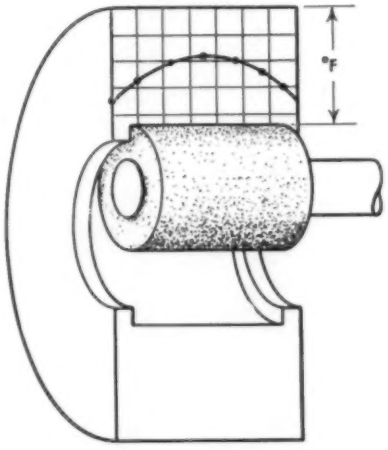


FIG. 1. Section through plunge-ground bore, showing unequal temperature rise in the metal which results in barrel-shape bore on cooling.

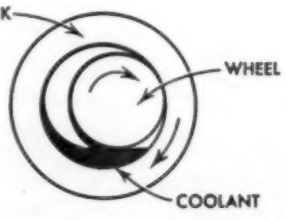


FIG. 2. End view of wheel and work, showing coolant flow for most effective dissipation of heat.

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THE tool AND manufacturing engineer

August 1961 Vol. 47, No. 2

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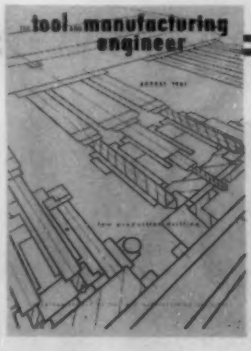
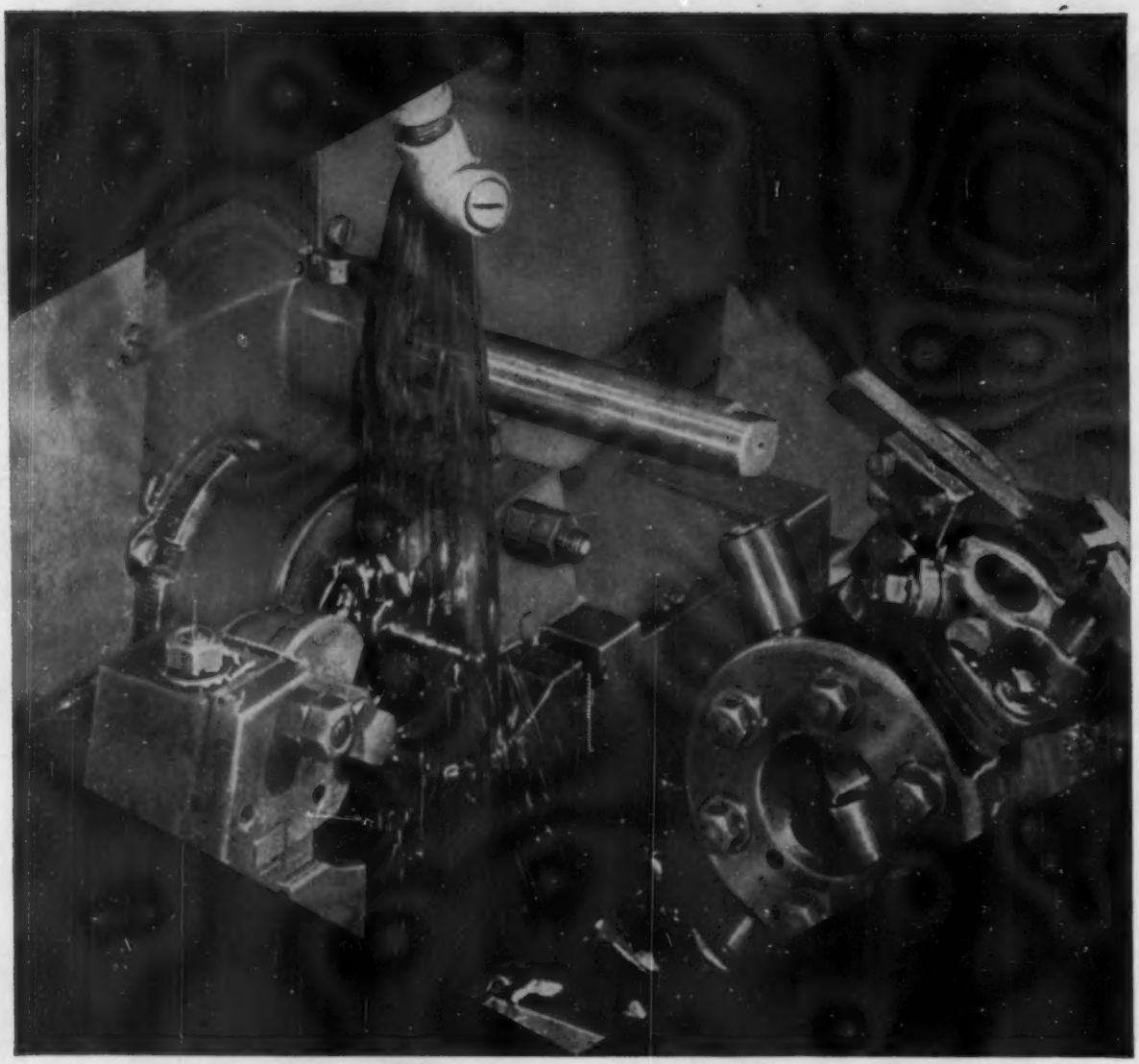
THIS MONTH'S COVER

Most of this magazine's covers show machines, tools and tooling in the round, the way they appear on the production floor. This month, the cover artist has chosen to depict a drilling operation as it is seen by manufacturing planners and tooling designers—a view that is equally familiar and significant to tool and manufacturing engineers. Harry Conn's article starting on Page 47 will be of special interest to this group.



THE TOOL AND MANUFACTURING ENGINEER is regularly indexed in the *Engineering Index Service* and *Applied Science & Technology Index*, used generally in libraries. The magazine is available in microfilm form at moderate cost.



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Increasing Productive Capacity

Realization that a machine may be obsolete to one group yet economically useful to another prompted Congressman Frank Kowalski to develop a plan for intelligent distribution of surplus equipment. Whether agricultural machines, machine tools or other industrial equipment are involved, his plan envisions a tool bank that would derive its machines from industry or the Government because of obsolescence in terms of age, design or capacity.

Foreign nations could draw upon this bank in accordance with clearly defined regulations, without any charge to them for the tools. U. S. agencies, engaged in overseas work, could also draw on the bank to carry on their projects.

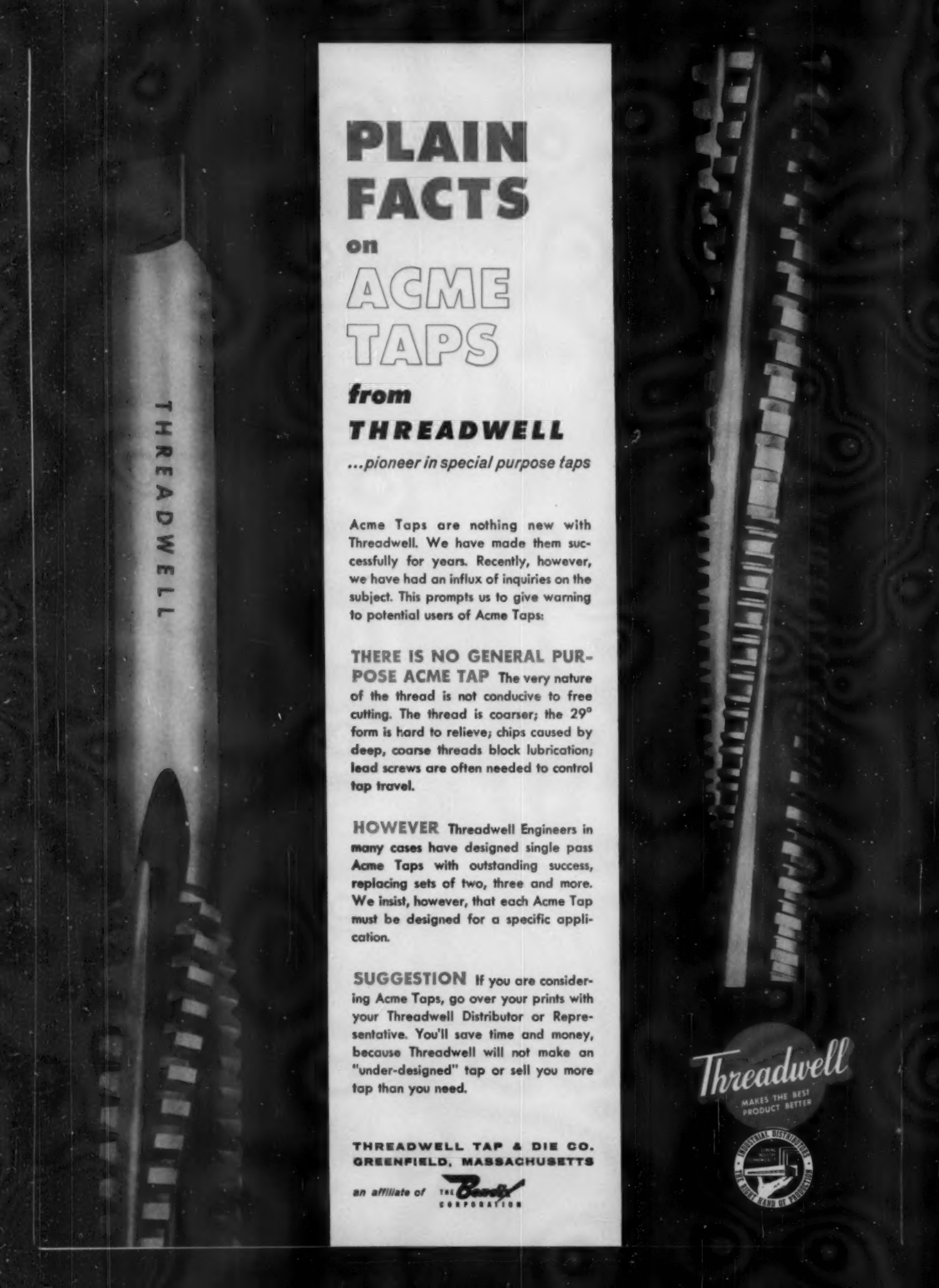
Objective of the plan is to give the machine tool industry and general manufacturing industries a shot-in-the-arm through the manufacture and use of more modern machines than could otherwise be made available. By improving the country's competitive position, more employment opportunities would be created for its workers.

The plan may have the earmarks of a blue-sky, give-away scheme. Further thought and study, however, develop intriguing possibilities that merit further study and analysis. In fact, the National Machine Tool Builders' Association, in conjunction with distributor and dealer organizations as well as government agencies, is studying plans similar to that for the tool bank.

Imagination and creative leadership are always essential to maintaining a competitive position. Whatever plan or combination of plans is developed and adopted it must contain the foresight necessary to keep our industries in high gear.

John W Greve

EDITOR



PLAIN FACTS on ACME TAPS from THREADWELL

...pioneer in special purpose taps

Acme Taps are nothing new with Threadwell. We have made them successfully for years. Recently, however, we have had an influx of inquiries on the subject. This prompts us to give warning to potential users of Acme Taps:

THERE IS NO GENERAL PURPOSE ACME TAP The very nature of the thread is not conducive to free cutting. The thread is coarser; the 29° form is hard to relieve; chips caused by deep, coarse threads block lubrication; lead screws are often needed to control tap travel.

HOWEVER Threadwell Engineers in many cases have designed single pass Acme Taps with outstanding success, replacing sets of two, three and more. We insist, however, that each Acme Tap must be designed for a specific application.

SUGGESTION If you are considering Acme Taps, go over your prints with your Threadwell Distributor or Representative. You'll save time and money, because Threadwell will not make an "under-designed" tap or sell you more tap than you need.

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preview

Controlling Production Costs

Statistical methods similar to those used in quality control can be profitably applied to controlling production costs. O. William Irving, who is quality assurance director for Fancher Furniture Co., shows how upper and lower limits for production costs are established and actual trends charted. If production costs go up in any one department, the need for action is apparent at once and corrective measures can be taken immediately. The statistical control charts are easier to analyze and interpret than columns of figures and they provide a sensitive measure of performance. Sample charts are included in the article, page 41.

Short-Run Drilling

Harry Conn, ardent advocate of "optimization" —getting optimum efficiency out of machines and tools—has turned his attention to drilling operations. His finding: high-production techniques can often be applied to small-lot production, with a consequent savings in time and money. The secret is to design tooling that is extremely versatile and that can be set up in a hurry. Mr. Conn, who is chief engineer of Scully-Jones & Co., includes some interesting examples of modern drilling techniques in his article, page 47.

Optical Tooling

When W. J. Mariner and his associates at Clark Bros. Co. were faced with the problem of establishing crankshaft and cylinder bore centerlines in a 5500-hp natural gas engine, they found that optical tooling was the only possible means of obtaining the required accuracy. Mechanical checking methods were out of the question because of the size of the 29½-foot-long block. Mr. Mariner tells the readers of this magazine how suitable optical checking methods were devised for this complex workpiece, and his article contains numerous photographs and drawings that show exactly how checking was performed. See the article starting on page 51.

More About Grinding Fluids

Concluding his three-part series of articles, Norton Co. grinding expert Dr. Leo Tarasov describes the various types of grinding fluids and gives explicit instructions on their selection and use. In addition to their effects on grinding efficiency, grinding fluids may affect the wheel condition, the workpiece and the machine operator. The knowledgeable discussion starting on page 57 should make the decision between various fluids for a specific application an easy one.

Gear Stresses

An understanding of gear stresses is important to sound gear design. These stresses, invisible in a metal gear, can be made visible by passing polarized light through a plastic gear. Stresses appear as dark lines or fringes. Until recently, all stress investigations of this kind were made statically. Now, with a new test method devised at Wayne State University by James Irvine and Joseph Silvagi, gear stresses can be checked dynamically, as gears rotate under load. Since the dynamic stresses in gears are quite different from static stresses, the new test method has already resulted in findings that may ultimately lead to improved gear design. Messrs. Irvine and Silvagi give the details in an article starting on page 67.

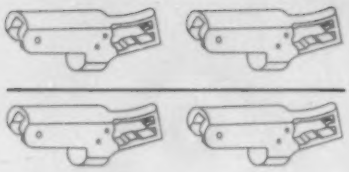
Production Scheduling

Charles H. Goodwin, Oneida Ltd. engineer, has developed an interesting and useful method of scheduling tooling programs. Because of the many fast-changing variables in tool construction—delays in steel deliveries, machine downtime, troubles in heat-treat, to name a few—an extremely flexible scheduling method is needed. Mr. Goodwin's system has this flexibility. The schedule board, for example, is magnetic and small magnets are used to show progress. See page 70.

Turning Aluminum

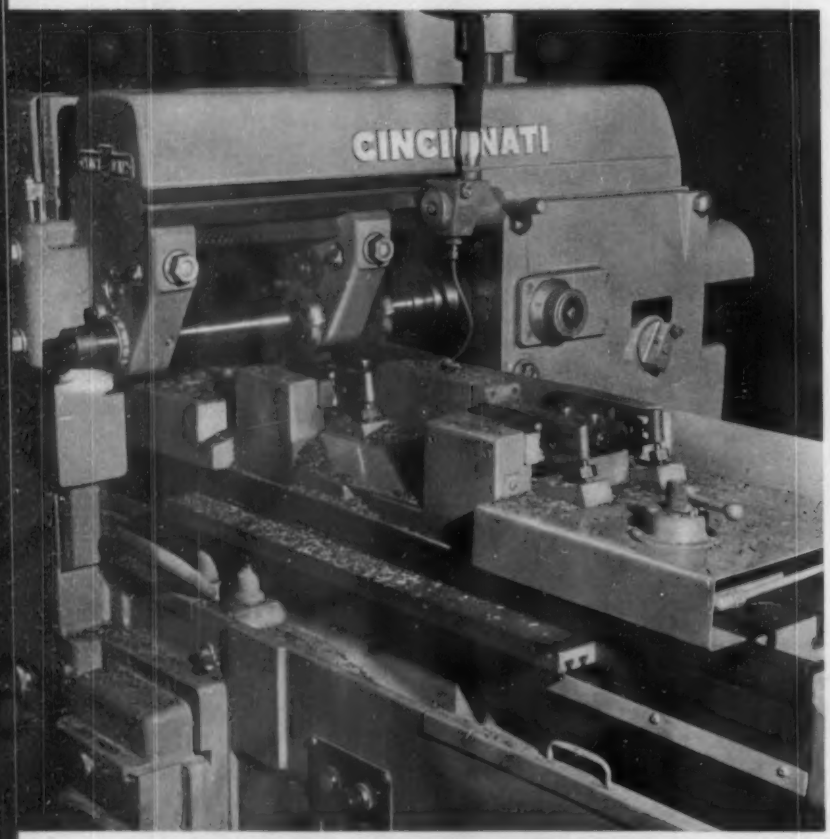
Athough most aluminum alloys are readily machinable, there is a considerable range of machinability and hardness among the various types of aluminum. Tables published with this month's reference sheet give specific feed and speed recommendations for 26 different aluminum compositions. When these recommendations are followed, optimum efficiency results. Page 71.

CINCINNATI

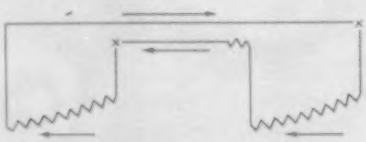


FOUR IN ONE TIMESAVING POWERMATIC CYCLE...

Four Parts Profile Milled Two Abreast



SHOTGUN FRAMES ARE AUTOMATICALLY PROFILE MILLED, *at a down-milling feed rate of 9-9/16 in./min., on this new* CINCINNATI *Powermatic Rise-and-Fall Milling Machine. The two-segment automatic cycle diagramed below, one of dozens available, is employed to profile mill four parts, two abreast.*



NEW CINCINNATI Powermatics give automatic cycle milling a new dimension in cost reduction. The example at the left shows one of the many unique possibilities. In a single timesaving cycle, bottom profiles are milled on four shotgun frames. They are mounted two abreast, in a Cincinnati designed, hydraulically operated fixture. Smooth down-milling, an advantage derived from Powermatic's automatic backlash eliminator, produces a superior finish and prevents springing of the work.

In addition to dozens of automatic cycles and the positive action automatic backlash eliminator, other Powermatic feature-advantages include:

- *Table feeds and spindle speeds easily changed* . . . simple pick-off gears; no wrenches required.
- *Single lever control* . . . starts the complete automatic cycle.
- *Effective chip and cutting fluid collecting system* . . . chip pans easily removed.
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Many additional feature-advantages give new CINCINNATI Powermatics the highest cost-reducing potential for medium-duty work, in high-volume and medium-volume shops. Get more information by asking for a copy of Catalog M-2167. **Milling Machine Division, The Cincinnati Milling Machine Co., Cincinnati 9, Ohio.**

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LOOKING AHEAD

By T. W. Black
Senior Associate
Editor

Developments in numerical control continue to come at a fast pace. IBM's recently announced Autoprompt computer program is expected to broaden the application of numerical control because it simplifies programming. The programmer provides a description of the part to be milled, tool sizes, tolerances required and general machining modes, in the Autoprompt language, which closely follows the English language. The computer, operating under control of the Autoprompt master program, generates from this input a complete series of detailed numerical instructions covering every operation the machine tool must perform. Because it minimizes programming effort, the new system makes numerical control feasible even for short-run production of complex three-dimensional parts or dies.

Although a complex part may be produced quickly and efficiently under numerical control, hundreds of man-hours may be required to inspect the part. A new numerically controlled inspection machine designed and built by Sheffield Corp. and using a Bendix control system makes such inspection fast and automatic, and gives a written record of all significant measurements. The five-axis machine can check workpieces up to 20 inches high and 20 inches in diameter, externally and internally. Repeatability of measurements is within plus or minus five millionths of an inch. This development is especially significant because of the size of the workpieces and the accuracy obtained.

Chemical and electrical energies are combined in a new gas burner developed by Arthur D. Little, Inc. The burner boosts the energy from ordinary combustion of a fuel-oxidant mixture by superimposing electrical energy from a low-current, high-voltage, alternating-current discharge on the flame. It can supply heat in the 3000-6000 F range for chemical and metallurgical processes such as open-hearth steelmaking. Boosting a natural gas-air flame electrically produces heat that melts a variety of metals, from copper to tantalum, which melts at 5400 F.

Use of one-half inch thick aluminum honeycomb material in place of solid laminates is making possible substantial reduction in plastic tooling costs. The honeycomb material provides a rigid and light-weight structure and eliminates much of the time-consuming layup work involved in making conventional tools. Hexcel Products Inc., Berkeley, Calif., reports that honeycomb structures have a one-to-six weight advantage over conventional materials.

Furane Plastics Inc., Los Angeles, Calif. reports that another aluminum-plastics combination is giving excellent results. Aluminum filled epoxy compounds have a better than average strength up to 400 F when used for tooling.

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Elimination of insert pocket results in larger end-cutting angle. Can be used on many tracer applications.
Minimum overhang of Carb-O-Lock reduces space requirements for locking mechanism.
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Insert changing and indexing is a breeze. Turn wrench to unlock, replace or index insert, then turn wrench to relock.
This is the shape of the sixties
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New Carb-O-Lock toolholder-insert combination cuts tool costs up to 40%!

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Truly unique in toolholder design, the Carb-O-Lock employs just three parts (not including insert)—compared with up to 12 parts in other toolholders. Using a cam-action locking principle, the Carb-O-Lock toolholder makes insert changing and indexing easy as one, two, three! And the streamlined design of this revolutionary toolholder lets you bring it closer to the work, with unrestricted chip flow.

Carb-O-Lock toolholders are available right now in toolholder shank sizes from ½" square to 2" square for square inserts and ½" to 1½" on toolholders for triangular inserts. The specially processed disposable inserts have been developed in Carboloy® Grade 883 for machining cast iron as well as many operations on high-temperature alloys, type 300 stainless steel, brass, and bronze.

They are held to tolerances of ±.002" on ¼" I.C. to ±.004" on the 1" square and they cost 40% less than some precision-ground (±.001") inserts.

These inserts have cutting edges composed of whole carbide crystals which are stress free, and notch free like Carboloy Pre-Honed inserts. And, to make your changeover easier, Carb-O-Lock inserts are designed to fit most square or triangular negative rake toolholders you may now be using.

Carb-O-Lock inserts come skin-packed on a file-drawer size, color-coded card for easier inventorying, faster identification.

See just how this brand new toolholder-insert combination can bring *better profits through better tooling* in *your* metalcutting operation. Phone your Authorized Carboloy Distributor and place your order for the Carb-O-Lock toolholder-insert combination.

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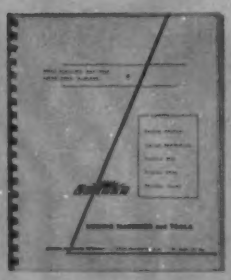

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In many cases, it's impossible to produce true-round bores in thin-walled parts by any process that requires chucking. Reason: They "spring back" when chucking pressure is relieved. Cutting tool pressure and heat generated during stock removal will also distort many thin-walled parts.

SUNNEN HONING solves all these problems! With this efficient stock removal process . . . no chucking is required because the work piece "floats" on the honing tool. *Chucking distortion is eliminated!* Stock removal is fast . . . with relatively low pressure and surface speed. *Distortion from cutting pressure and heat is eliminated!* Results: A geometrically true-round, straight bore.

Production tolerances held on the 1¾" bore stainless steel cylinder shown above are ±.0002". . . with 8 micro-inch finish and .003" average stock removal.

Your own machining problems may not be quite this difficult, but Sunnen Honing will save you money if you do internal work of any type. It guarantees accuracy to .0001" with any desired finish down to 2 micro-inches

8922

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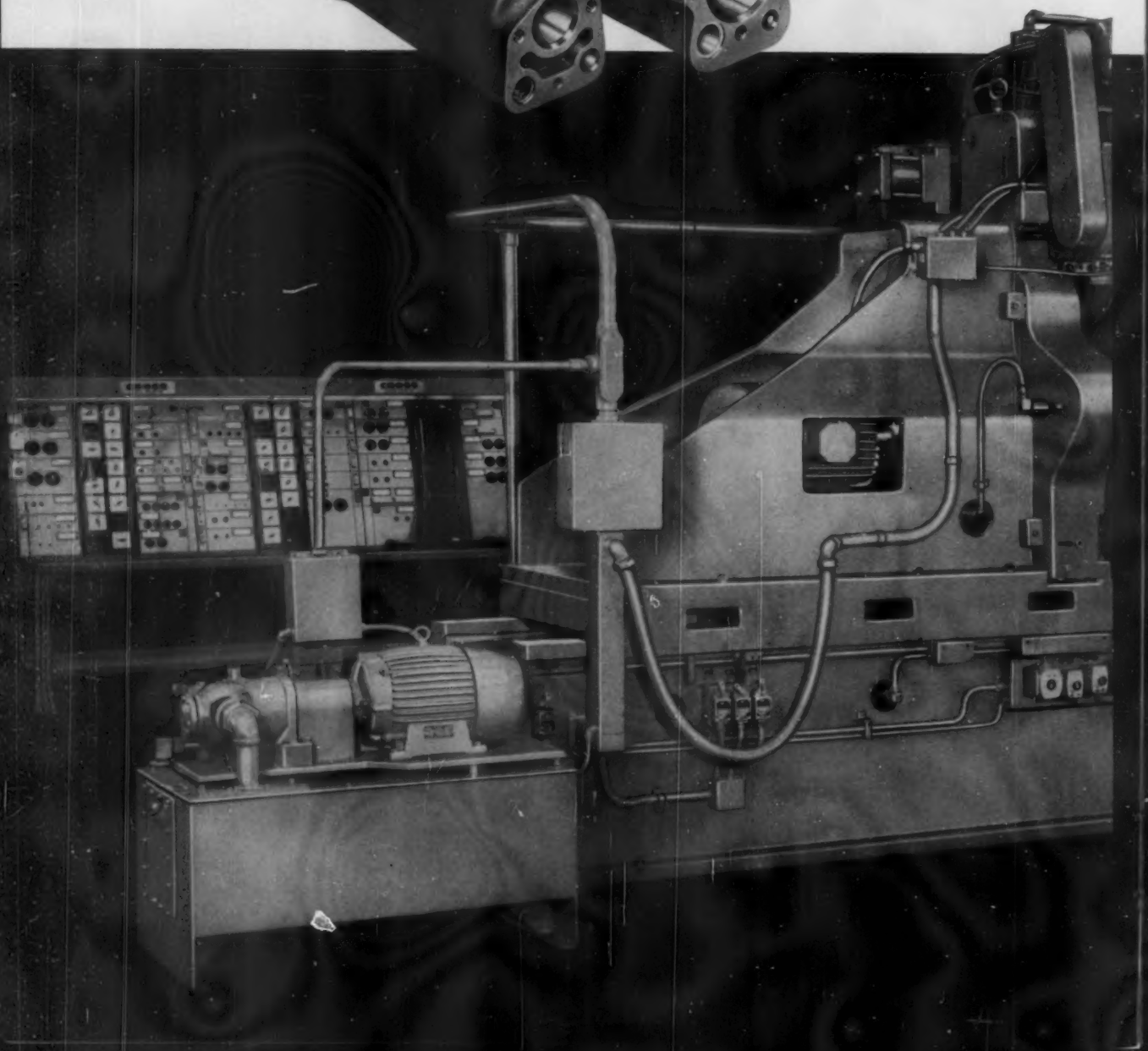


Another Automation First by Cross

Recent developments by Cross have resulted in trunnion machines that perform a variety of operations on families of parts with improved accuracy and at a higher rate of production than previous equipment.

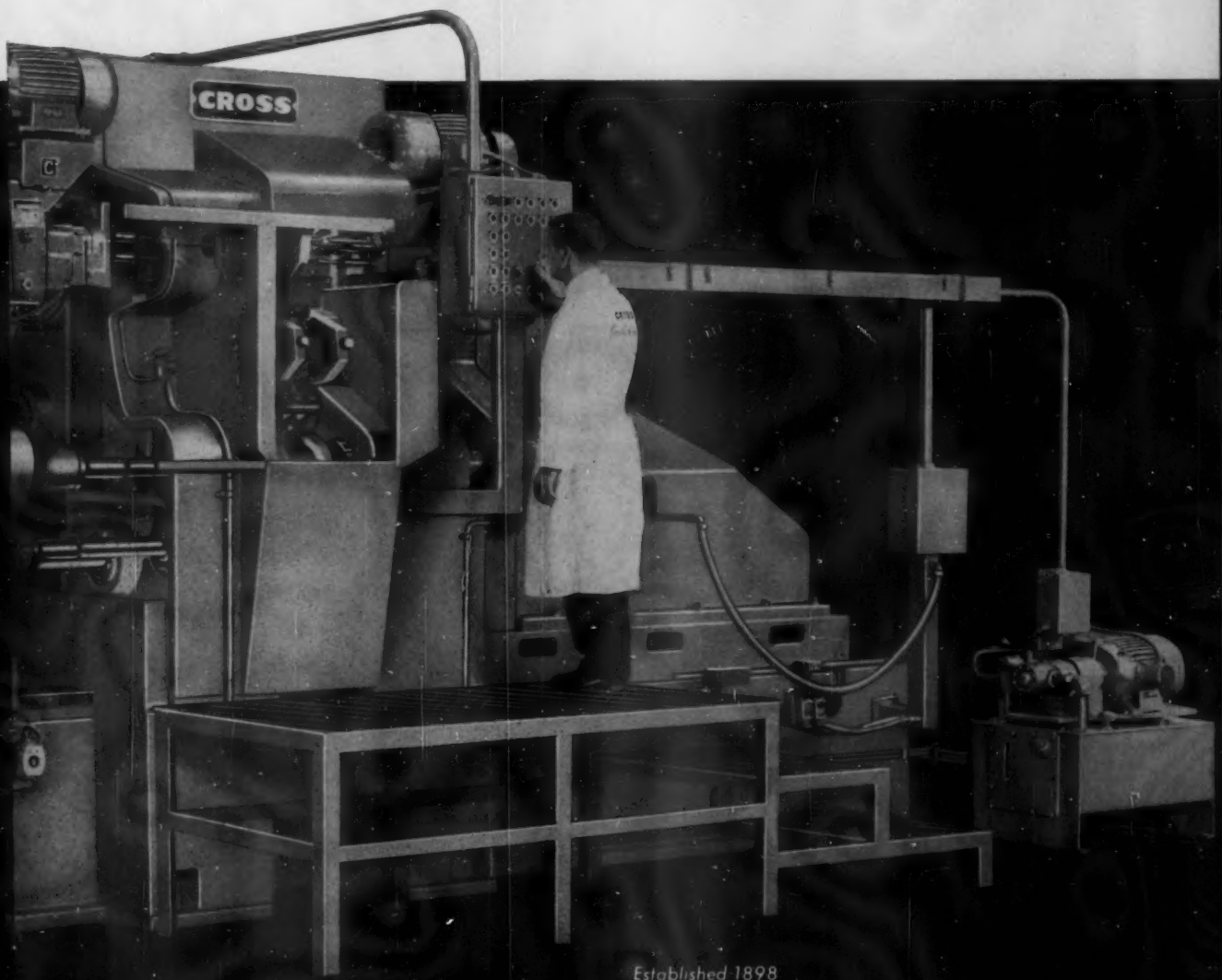
A typical application of the new design concept is the processing of remote accessory cylinders which vary in both size and material. Different lengths are handled by changing a few tools, replacing some fixture details and adjusting the feed strokes. Both nodular and grey iron castings are processed by changing the speeds and feeds.

Similar operations such as rough, semi-finish and finish boring; drilling; counterboring and chamfering are completed by spindles in the two main heads. Dissimilar work such as tapping, facing and grooving are done by four auxiliary heads.

Extremely close tolerances are maintained through single clamping of the part, precision indexing of the trunnion and boring bars which are accurately guided in the trunnion supports.

Future part design changes can be accommodated easily because of the extreme flexibility of the machine.

A Cross Sales Engineer will be glad to tell you more about this new trunnion machine design.



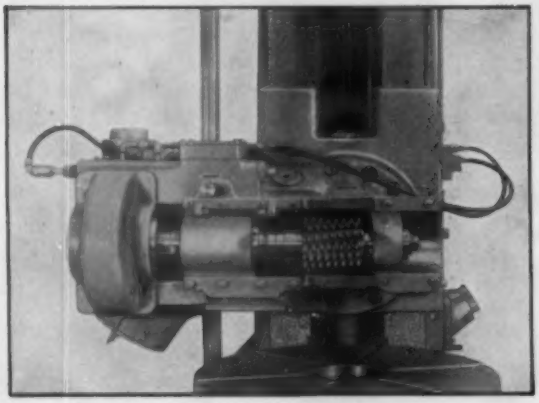
Established 1898

THE CROSS CO.

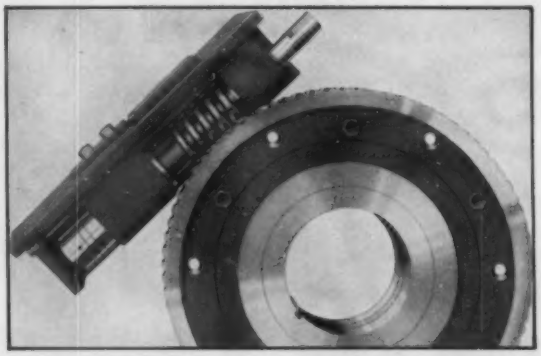
First in Automation

PARK GROVE STATION • DETROIT 5, MICHIGAN

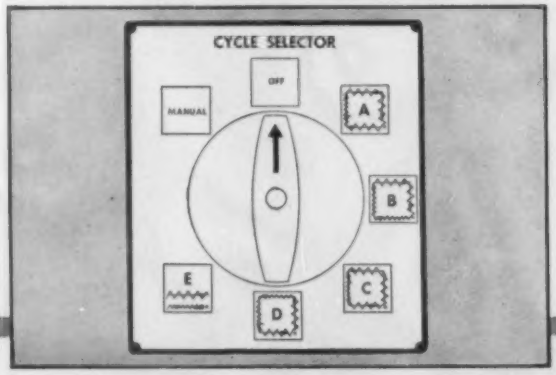
On G&E Gear Hobbers you can get features like these...



Automatic hob shift apportions wear over entire hob length, throughout roughing and finishing operations. Hob spindle bearings rigidly clamped during cut.



DUALEAD worm gearing assures accurate indexing under heaviest production, at high operating speeds. Worm thread design simplifies adjustment, improves backlash control, assures uniform motion in both directions of rotation.*



Automatic Quadcycle with rough and finish cycle option makes gear cutting completely automatic. Operator needs only to load work and push RUN button. Specific cycles in an operation are selected by a single setting-dial.

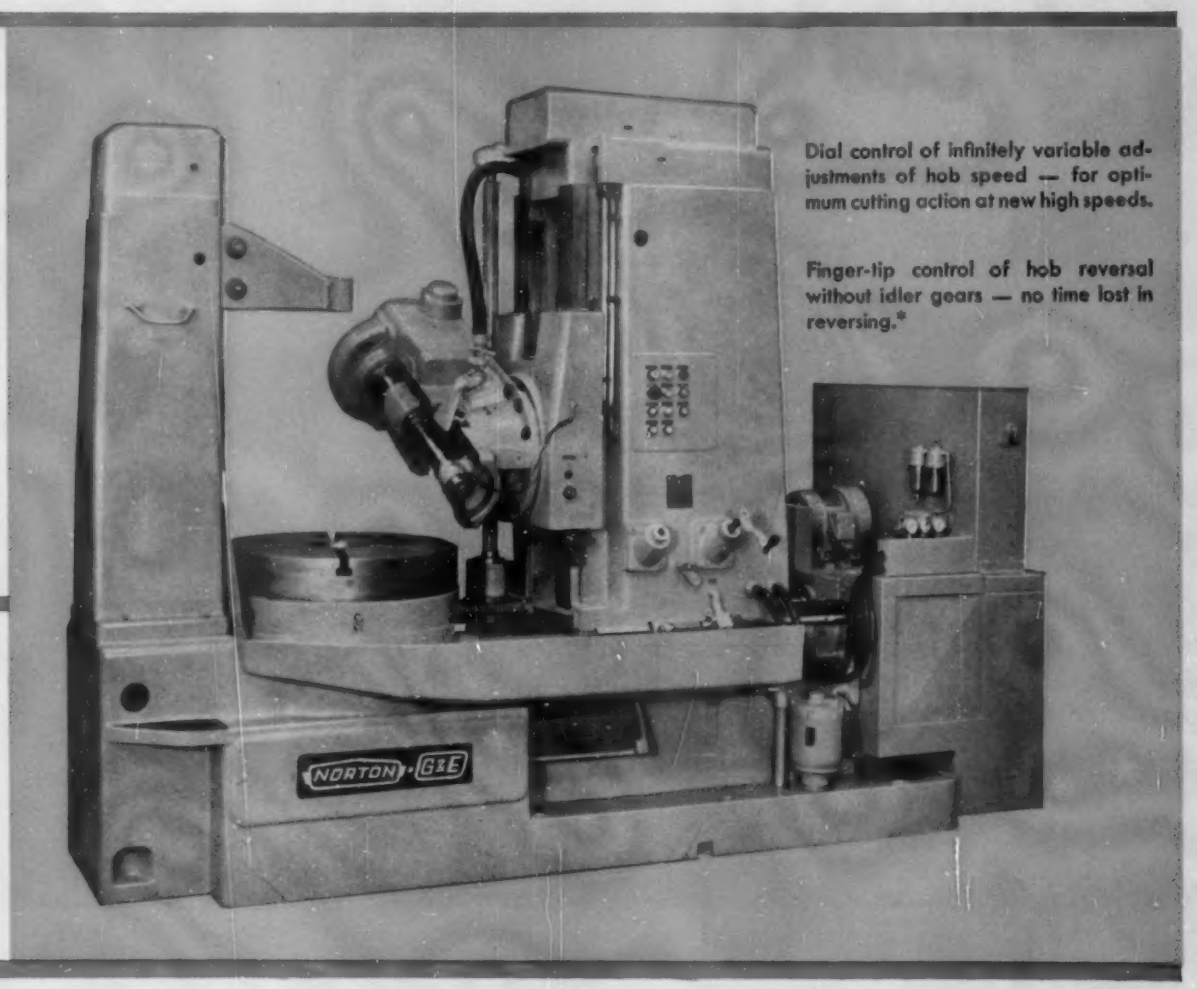
plus advantages like these...

- Hydraulic counter balance of hob slide — variable to meet cutting conditions — eliminates backlash and chatter, permits high hobbing speeds, lengthens hob life.
- Tracer-controlled crown hobbing accurately produces a total amount of crown within a few "tenths", per inch of face. Simple inexpensive template locates high point and amount of crown anywhere on gear face. Also applicable to highly crowned couplings.

*Standard equipment

NORTON PRODUCTS: Abrasives • Grinding Wheels • Machine Tools • Refractories • Non-Slip Floors — BEHR-MANNING DIVISION: Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

with everything under control!


Dial control of infinitely variable adjustments of hob speed — for optimum cutting action at new high speeds.
Finger-tip control of hob reversal without idler gears — no time lost in reversing.*
NORTON · G&E

Outstanding accuracy has long established G&E Universal Gear Hobbers as the most dependable machines for practically every gear cutting application.

Precision performance is built into every G&E Hobber . . . with many advanced optional features like the ones described here . . . and with a simplified, control system that increases automatic, cost-cutting benefits in sustained high production.

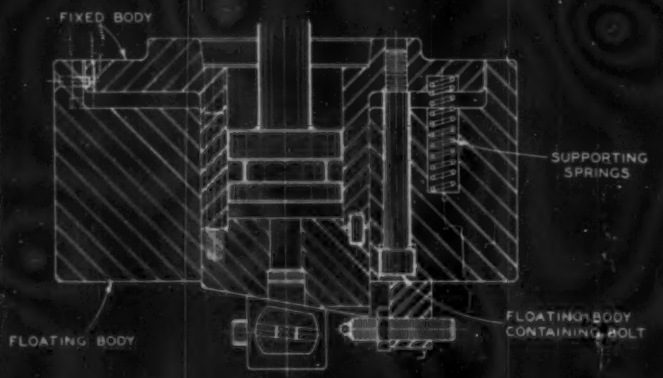
G&E Hobbers are made in ten sizes to produce gears from one inch to fifteen feet in diameter, with most features available on all.

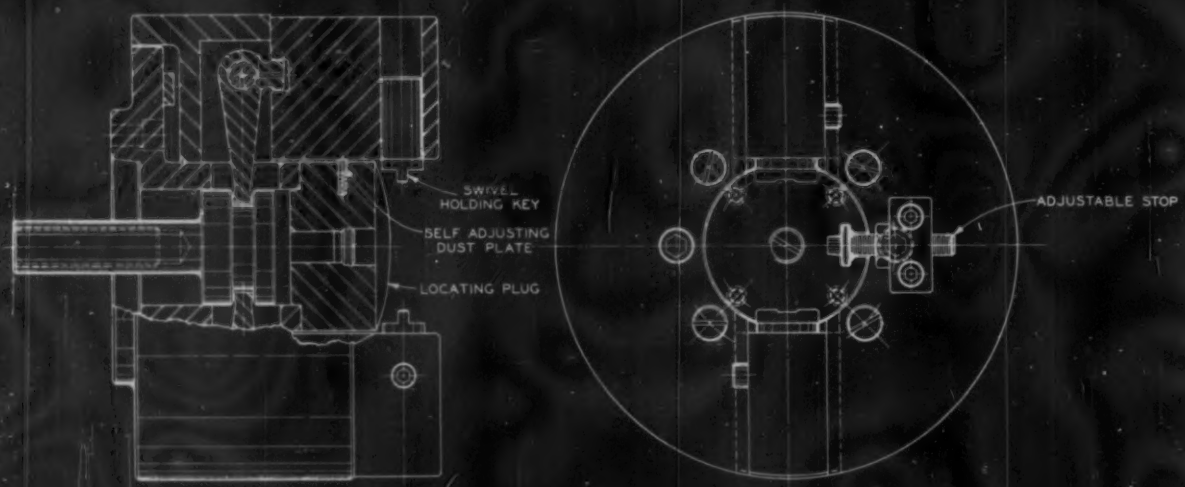
For expert aid in selecting gear hobbers and other G&E machines, see your G&E distributor — or write to Norton Company, G&E Division, Worcester 6, Massachusetts.

NORTON
MACHINE TOOLS
Making better products
. . . to make your products better

MACHINE TOOL DIVISION: Grinding and Lapping Machines — G & E DIVISION: Shapers • Gear Cutting Machines

Special CHUCKS

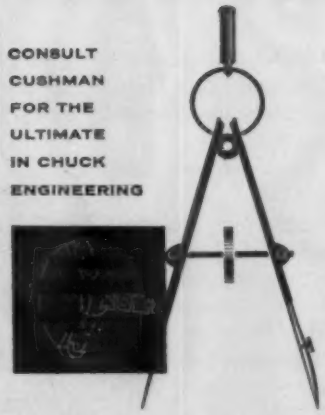




The assembly print reproduced above is but one of many examples of special chucks designed and engineered to meet most unusual workholding and machining requirements. Cushman Special Chucks are being used in many diverse industries enabling manufacturers to meet realistic production quotas, maintain close tolerances, and achieve lowest costs on both short or long runs.

If you have a workholding problem, consult Cushman. Your problem may have already been solved.

CONSULT CUSHMAN FOR THE ULTIMATE IN CHUCK ENGINEERING

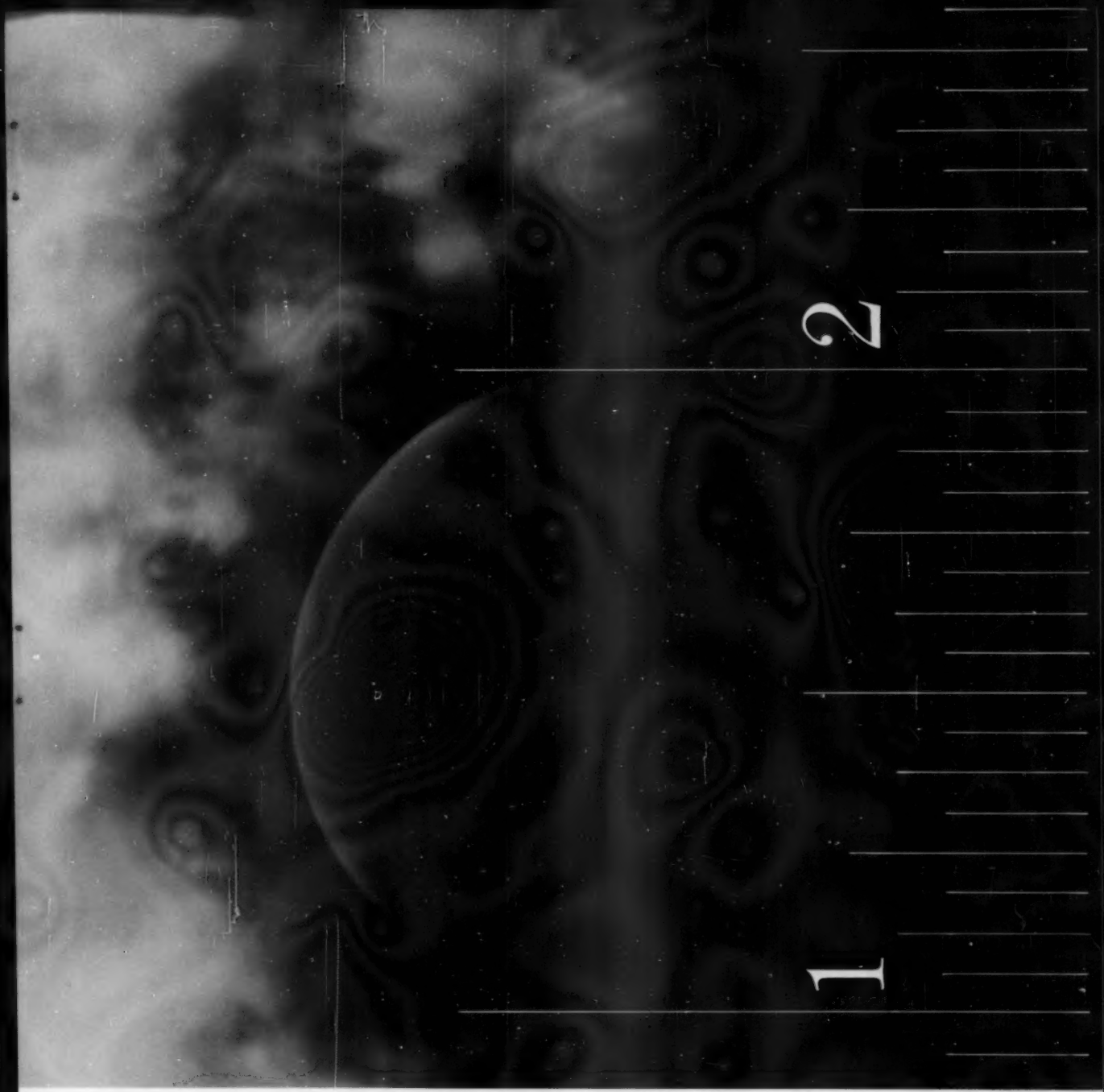


THE CUSHMAN CHUCK COMPANY · HARTFORD 2, CONNECTICUT

Manufacturers of Air and Manually Operated Chucks, Power Wrenches, and Face Plate Jaws.

Use Reader Service Card, CIRCLE 16

Use Reader Service Card, CIRCLE 17



OUR PRECISION IS LAW!

This is a world of rockets and satellites. Of thoughts to soar to the moon. In this world, Pratt & Whitney gages are the standards of precision! Today you must work to increasingly exacting tolerances, whatever your product, whatever the size of your company. Otherwise, your work is rejected internally or by your customers. You cannot afford to lose money on any phase of your gaging operations. You can make sure you don't. You can help win your battle for economic survival by insisting on Pratt & Whitney gages. The high quality, accuracy and longer life of these precision gages permit us to say: Our Precision is Law! You Are Not **Really** Measuring Unless You Are Using Pratt & Whitney Gages!

Pratt & Whitney

HEADQUARTERS IN AMERICA'S WAR AGAINST OBSOLESCENCE

machine tools / cutting tools / gages

A MAJOR INDUSTRIAL COMPONENT OF **FAIRBANKS WHITNEY CORPORATION**

YOU LOSE PRECISION AND MONEY WITHOUT PRATT & WHITNEY GAGES!

No company can afford to defraud itself! It must use the best gages. Gages that accurately and consistently measure to exacting standards. Gages that decide whether products are accepted or rejected by you **or by your customers!**

Every component of a Pratt & Whitney gage is given the ultimate in skilled workmanship. Thus, the gage itself lasts longer. And it maintains its accuracy over this longer service-life span. This makes Pratt & Whitney Gages the best investment any company can make in its future, from the cold, hard standpoint of money saved!

No product is more accurate than the gage used to measure it. You must make sure that you get the finest. This means Pratt & Whitney! Behind every gage is P&W's 100-year experience in making the most precise gages that can be made. See us about your gage requirements **now!**

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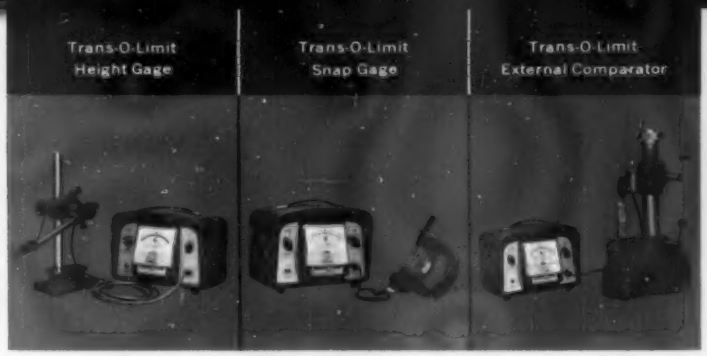


TRANS-O-LIMIT COMPARATORS

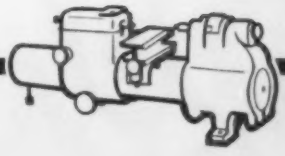
Here are three of an entirely new line of easily-portable, completely transistorized, precision P&W gages. This new line includes a series of Trans-O-Limit read-out cabinets which can be used with the Trans-O-Limit Height Gage, External Comparators, Cartridge Units, or Snap Gages. Developed and engineered to provide the ultimate in gaging stability, precision and reliability.

YOU CAN'T AFFORD **NOT** TO USE THE NEW AIR-O-LIMIT COLUMN GAGE! *Fast . . . Versatile . . . Dependable*

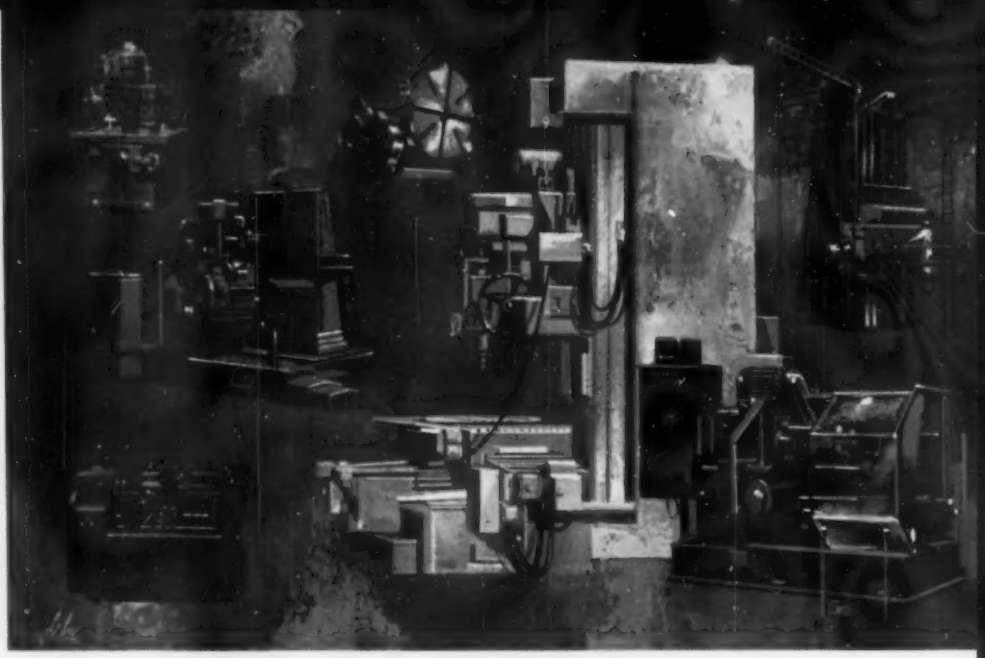
This air flow gage is the latest result of P&W's constant research in the field of pneumatic gaging. A mechanically simple gage, with a longer life than other gages. Available with one or more columns. Modular construction permits you to use one combination of components today—an entirely different combination tomorrow. For use with a large variety of internal and external gaging attachments for rapid, consistently-accurate checking of a wide range of products. The time and money saved by using this revolutionary gage truly means that you can't afford **not** to use it!

A COMPLETE LINE OF P&W GAGES . . .

In addition to the Trans-O-Limit and new Air-O-Limit Column gages, P&W offers the following types of gages: Basic Measuring Machines, Electro-Limit Comparators, Helical Path Analyzers, Continuous Gages, and X-Ray Gages. P&W has a standard or special gage for every application.



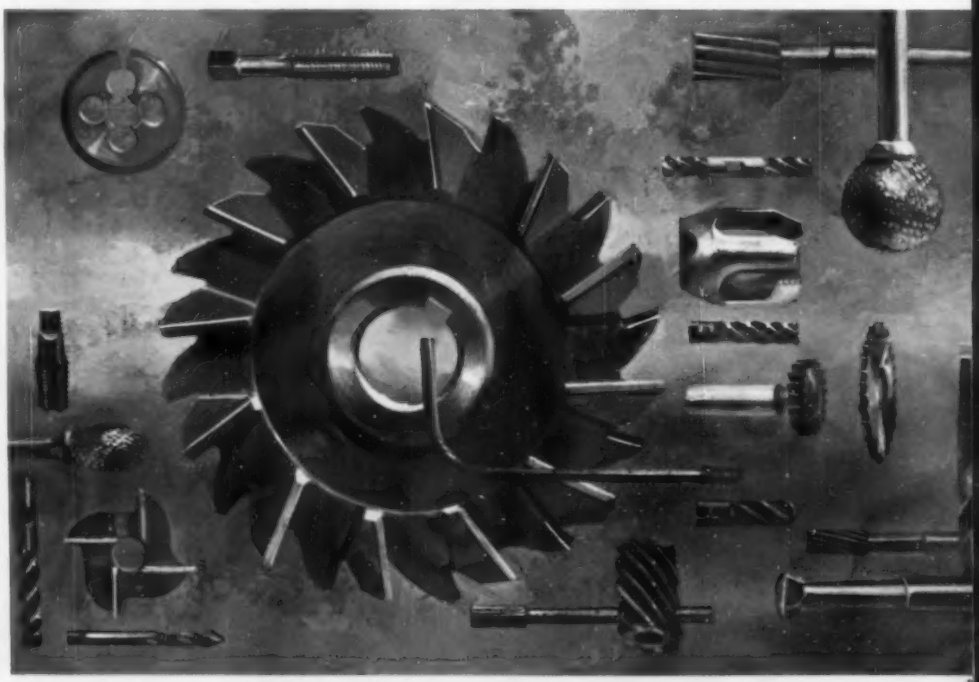
P&W MACHINE TOOLS
Are you producing prototypes, dies, large or small lots of production parts? Ultra-precision locating (to "tenths" accuracy)? Boring, profile milling (with or without masters)? All these and countless other problems can be solved with P&W machine tools at production line speed, efficiency and economy. Machines such as the world-famous P&W KELLER,® P&W JIG BORER, P&W ROTARY TABLE and P&W POTTER & JOHNSON AUTOMATIC TURRET LATHE are available with manual or numerical controls in a variety of models to fit your needs. P&W can also supply the MAGNETRACE PROFILER, SIM LATHE, INNOCENTI-MITSUBISHI MILL and the DIAFORM WHEEL FORMING ATTACHMENT...high grade performers all. For more information ask your P&W representative.



IN YOUR FIGHT TO **SURVIVE** YOU NEED THE FINEST WEAPONS

P&W's recently inaugurated policy of making P&W Cutting Tools and Conventional Gages available through factory-trained and selected Industrial Distributors makes personalized local service available to you . . . to simplify purchasing and speed delivery from local stocks.

P&W Cutting Tools include: Drills . . . Taps . . . Dies . . . Milling Cutters . . . Reamers . . . Burs, End Mills . . . in HSS and solid carbides.



MACHINE TOOLS – CUTTING TOOLS – GAGES • HEADQUARTERS FOR AMERICA'S WAR AGAINST OBSOLESCENCE

PRATT & WHITNEY
A MAJOR INDUSTRIAL COMPONENT OF
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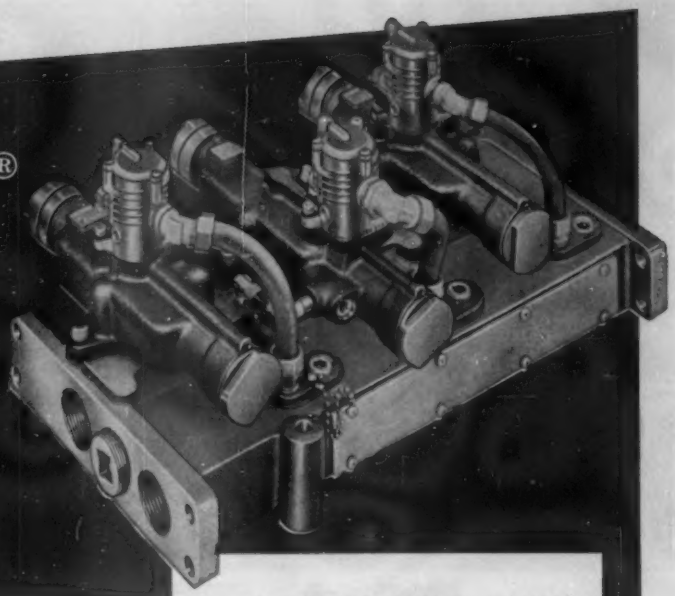
PRATT & WHITNEY COMPANY, INCORPORATED, CHARTER OAK BOULEVARD, WEST HARTFORD, CONNECTICUT

SPEED KING® Deceleration Manifold



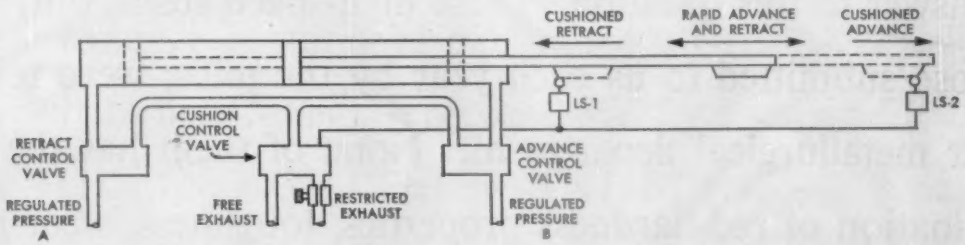
Controlled by limit switches, the deceleration unit permits rapid initial cylinder travel . . . then restricts cylinder exhaust to provide desired rate of cylinder cushioning. And, if needed, live air can be introduced momentarily to the exhaust side of the cylinder for added deceleration and cushioning.

...for positive cushioning of high speed transfer units

The Speed King deceleration manifold controls double-acting cylinders on automated equipment moving masses weighing several hundred pounds . . . where rapid travel and precise, easily regulated cushioning, at any point in either or both directions, is required.

Rapid travel keeps production rates high . . . controlled deceleration and positive cushioning prevents damage to mechanisms . . . protects valuable dies and tooling.

Your Bellows-Valvair Field Engineer can advise you on control of large, fast-moving reciprocating units. Call him today.

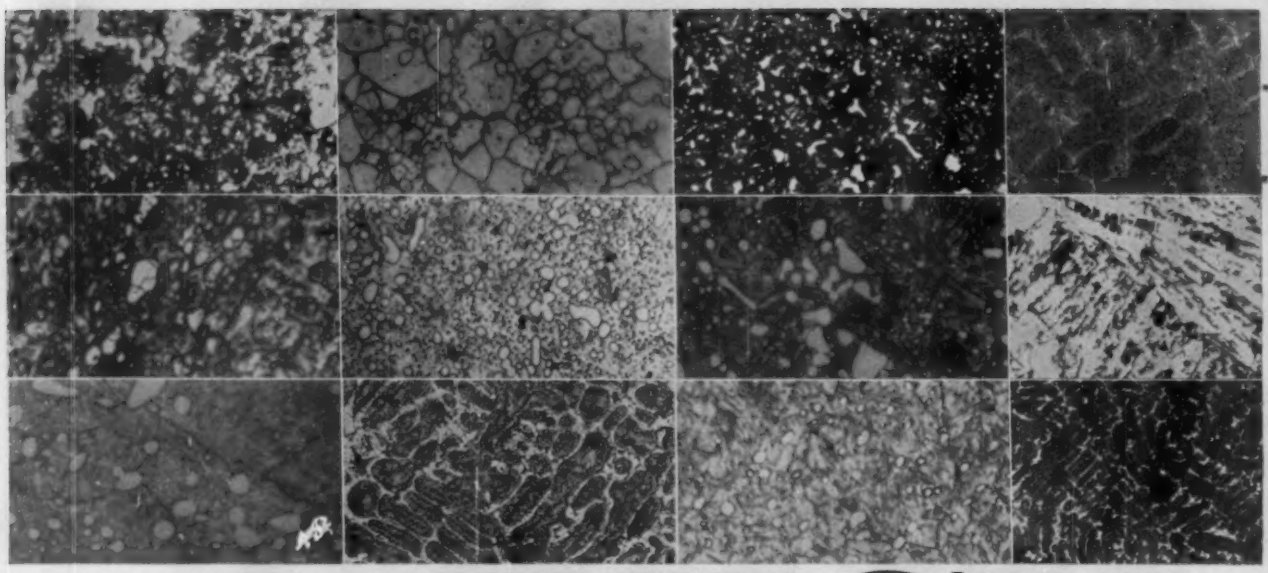


- **RAPID ADVANCE** . . . advance control valve opens and exhausts to cushion control valve. Cushion control valve, de-energized, directs cylinder exhaust to free outlet.
- **CUSHIONED ADVANCE** . . . advance control valve remains energized. LS-2 energizes cushion control valve, diverting cylinder exhaust to restricted outlet.
- **RAPID RETRACT** . . . retract control valve exhausts to cushion control valve, which de-energized, directs cylinder exhaust to free outlet.
- **CUSHIONED RETRACT** . . . retract control valve remains energized. LS-1 energizes cushion control valve, diverting cylinder exhaust to restricted outlet.

Write for Bulletin MAN-11. Address Bellows-Valvair, Akron 9, Ohio, Dept. TE-861.

Bellows-Valvair
AKRON 9, OHIO
DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

8180

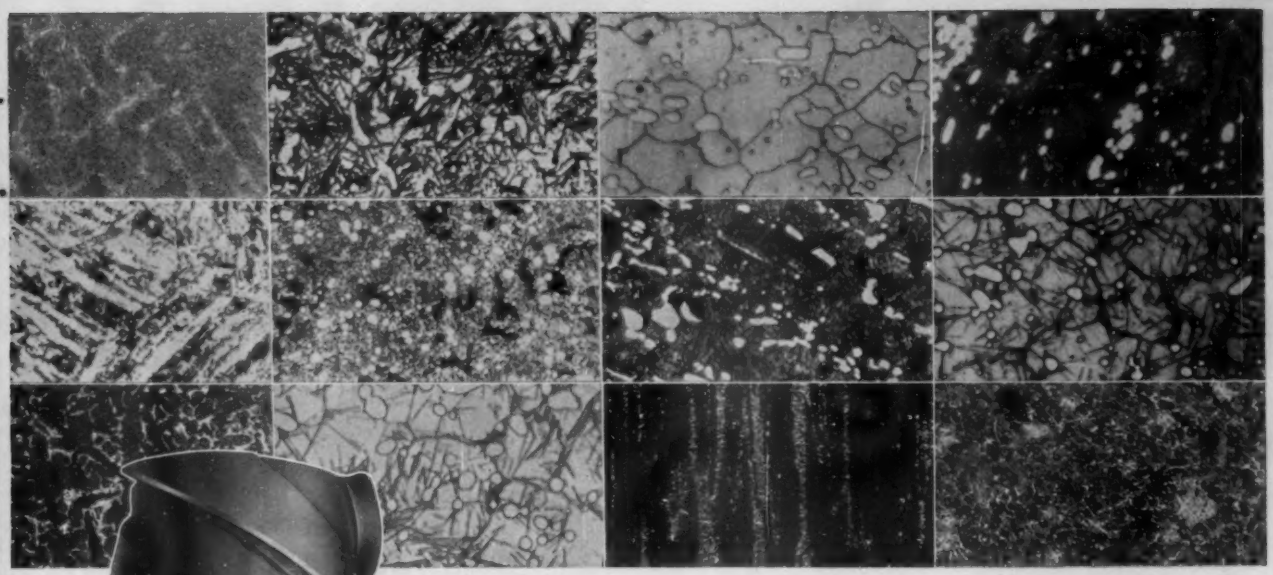


WHICH STEEL

■ It's a good idea to buy cutters from a company that knows

MAKES THE BEST CUTTER?

the answer to this question. These high-speed steels, only a few of those submitted to us each year by the mills, were rejected in our metallurgical department. None of them has the right combination of red-hardness properties, toughness, wear-resistance, hardenability, and stability under heat treatment. Every Barber-Colman cutter, no matter what the size or price, is made from mill-selected tool steels which meet our own metallurgical standards. Every cutter starts in our shop with a complete metallurgical check–not only to determine correctness of ma-



terial, but also to provide data to be used by our engineers and toolmakers in producing the finest possible tools from that material. ■ Look-alike cutters can be miles apart in quality. Your best test is total COST-PER-PIECE, and your best bet is Barber-Colman quality. (Complete range of standard cutters for off-the-shelf delivery.) Ask your Barber-Colman representative for a copy of the hard-cover MILLING CUTTER HANDBOOK – 219 pages of useful information on selection, use, and care of milling cutters. NOTE: Your special cutters receive individual material analysis, selection, and heat treatment if you specify type and hardness of metal to be machined.

BARBER COLMAN

BARBER-COLMAN COMPANY 83 LOOMIS STREET, ROCKFORD, ILLINOIS

Ex-Cell-O Model 922 Numera-Trol . . .

PRECISION IN MILLIONTHS PLUS COMPLETE VERSATILITY!

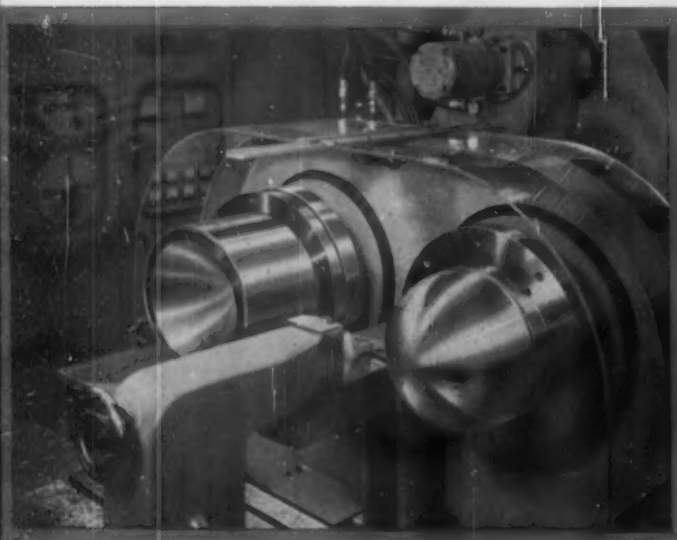
Interchangeable, self-contained units provide a universal, tape-controlled "production center" for . . .

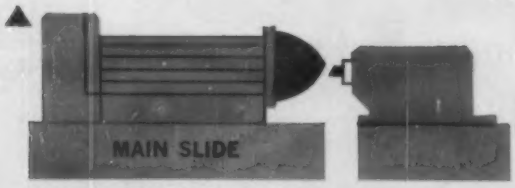
. . . Single and Double-spindle Boring and Turning
. . . Templet Grinding and Scribing
. . . Flat Circular Cam Grinding
. . . 3-Axis Vertical Contour Milling

Ex-Cell-O's Model 922 Numera-Trol Machine gives you extremely broad design and manufacturing capabilities in a single production machine tool controllable to 25 millionths of an inch.

Interchangeable precision machining units mount on the main slide, and simply "plug in" to the machine's hydraulic, electrical and continuous-path numerical control circuits. In most cases, the Model 922 can be completely retooled and ready for entirely different, fully-automatic production in a few hours.

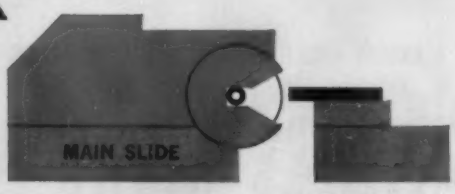
Send today for engineering and performance data, or call your Ex-Cell-O Representative for complete specifications.





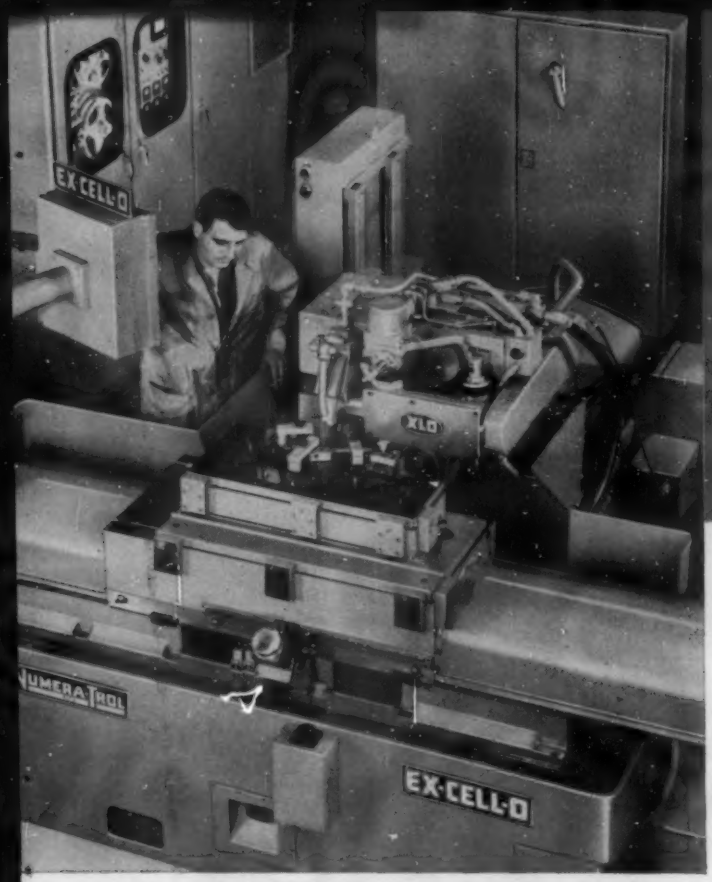
Single and Double-Spindle Turning-Boring Unit

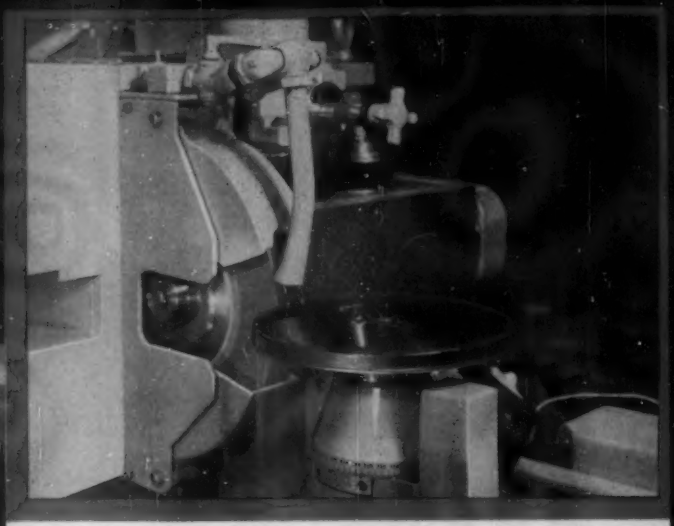
- Variable-speed workheads on main slide maintain constant surface speeds.
- Manual or automatic control of slides in .000025" increments.

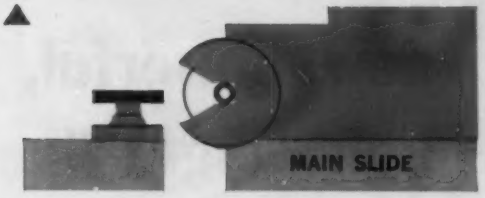


Templet Grinding-Scribing Unit

- Accommodates wheels up to 12" diameter on main slide.
- Manual or tape-controlled wheel dressing, size compensation and cycling.





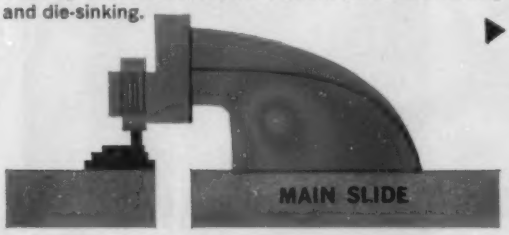


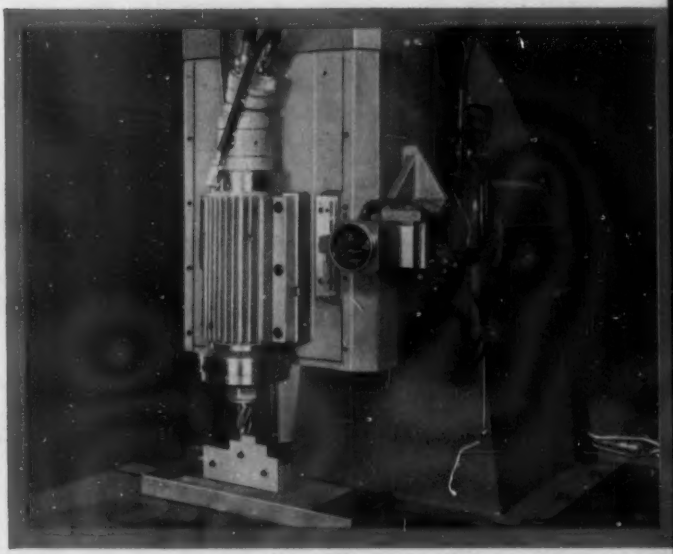
Flat Circular Cam Grinding Unit

- Adjustable, vertical-oscillating wheel spindle for flat-edge grinding.
- Tape-controlled rotary indexing fixture on cross-slide.

3-Axis Vertical Contour Milling Unit

- 6″ vertical column movement, 18″ main slide travel, 26″ cross-slide travel.
- Designed for extremely close-tolerance contour milling and die-sinking.





There's a Series 900 Numera-Trol to meet your most difficult jobs! Contact your Ex-Cell-O Representative, or write for literature on tape-controlled Ex-Cell-O Series 900 Numera-Trol Machines: Models 905 and 920 for both hemisphere and free-form boring and turning; Model 924 for grinding flat circular cams; the universal Model 922; and the Model 952 drum-cam and blade contouring machine.

61-22M

EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • PRECISION PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

NOW

New 12B2R Inline Screw Driver.

new, powerful, lightweight line of reversible air tools

Here's a new line of handy, lightweight, *reversible* air tools from Gardner-Denver—designed to keep your production lines moving at top efficiency. Screw drivers, nut setters—inline and angle types—are available with a complete selection of interchangeable attachments.

Powerful air motor. It's the motor that makes the big difference in these tools. Compact design houses more power, higher speed . . . provides lighter weight, lower noise level than ever before.

Reversibility. Saves valuable man-hours—assures accurate driving and setting—prevents sending assemblies to repair stations. Permits tightening both right- and left-hand threaded fasteners. Entire line also available in non-reversible models.

For famous Gardner-Denver versatility and interchangeability, get all the facts on this exciting new line of air tools. See your Gardner-Denver air tool specialist, or write for bulletins.

New 11B2 Series Inline Drill. New line also includes angle drills, ratchet wrenches, tappers.

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

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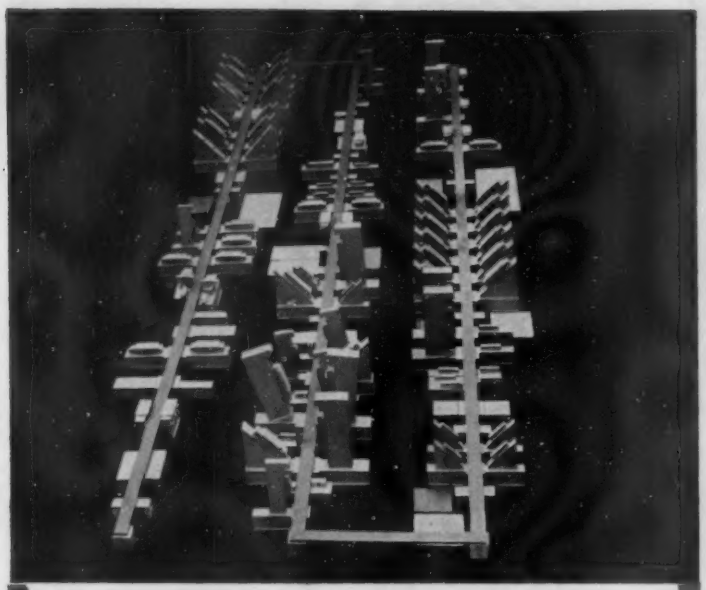


For economy, productivity, flexibility... EX-CELL-O BUILDING BLOCK UNITS!

- You get custom equipment, made from low-cost, standardized units.
- You can build simple one-way precision machines, or huge multi-station transfer machines.
- You can remove, relocate or add work stations to suit your production needs.
- You can arrange components for horizontal, angular, radial or vertical machining.
- You can partially or completely automate any sections.
- You can set up single or multiple functions—bore, counterbore, turn, drill, ream, face, chamfer and other operations.
- You can re-tool with standard Ex-Cell-O spindles, hydraulic power units and other accessories—and *know* all units will fit perfectly.
- You get faster delivery because standardization reduces engineering and build-up time.

If you're looking for manufacturing flexibility, look into Ex-Cell-O Building Blocks. Call your Ex-Cell-O Representative, or write for Bulletin 505911.

61-29M

EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

New—
CARMET'S 700 Series Cutting Grades and the fine art of making chips

Some people baby their carbide tools. They hold back a little on roughing cuts, because they've heard carbide is pretty brittle . . . and some of it is. Or they ease off on finishing cuts, because their tool may be too soft for long, fast passes . . . because it may wear or crater. And, some of it will.

But this is "paring-knife" machining, and it really isn't necessary. Not any more . . . not since Carmet introduced the 700 Series Steelcutting Grades. No paring knife made these chips . . . these were hogged out on a production basis by one of Carmet's new carbides . . . Grade CA-720.

The job: rough facing railroad axle forgings in an automatic tracer lathe—210 sfm—.076" feed—1¼" width of cut. The result: over 1,000 cubic inches of steel removed in 5½ minutes, floor to floor, with plenty of red hot chips like these. And, 35 axles per tool against 25 pieces for the best competitive carbide tool . . . a tool carrying a higher price tag.

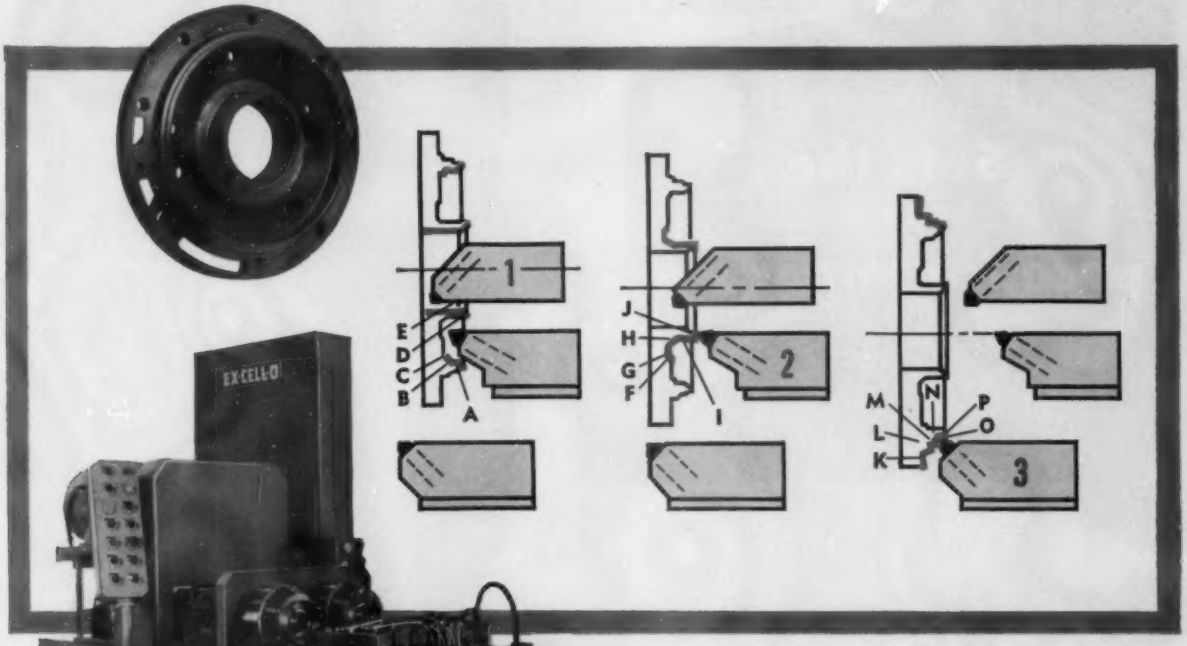
Carmet's 700 Series have the edge wear and crater resistance, *and* the ability to endure shock and heat, to breeze through jobs like this. They're doing just that all over the country . . . right now! Next time you're setting up a mean, tool-buster of a cut, let the 700 Series make chips and money for you, just once. Your Carmet Distributor has the local stock and all the information. Call him, or write:
Carmet Division, Allegheny Ludlum Steel Corporation, Ferndale, Detroit 20, Michigan. Dept. TE-8.

CARMET® AL

CEMENTED CARBIDE · DIVISION OF ALLEGHENY LUDLUM

2932

Ex-Cell-O Model 312 generates 21 surfaces per part!



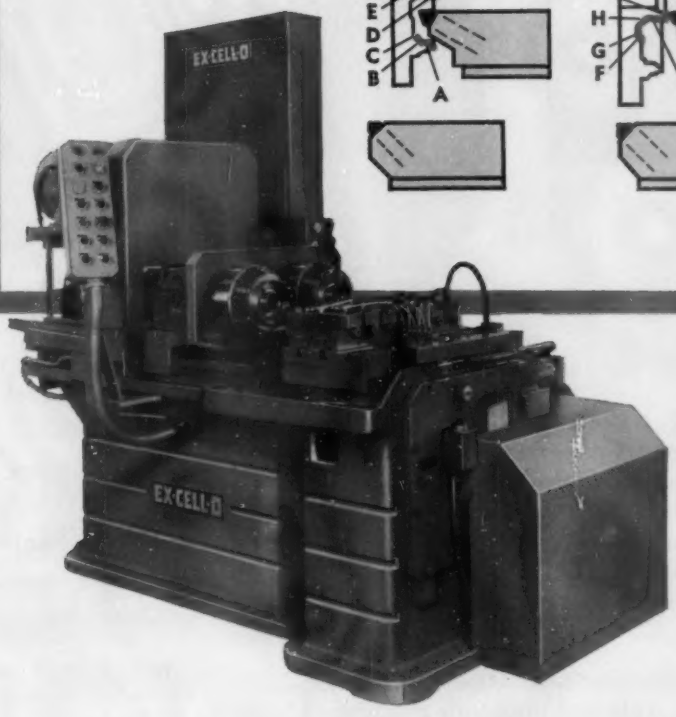


Diagram shows tools in quick-change magazines at the end of their strokes.

Tool No. 1 generates chamfer A, bores diameter B, generates radius C, traverses out, chamfers D and bores E.

Tool No. 2 generates surfaces F, G, H, I, and J with cam-controlled accuracy.

Tool No. 3 faces K, generates radius L, tapers M, turns N, chamfers O and generates radius P in cast-iron clutch assemblies.

Ex-Cell-O Cam-Operated Precision Boring Machines are designed especially for work requiring consistently precise boring, plunge-facing, grooving, chamfering and other O.D. and I.D. contours. Table and slide movements on hardened and ground ways are guaranteed by direct cam action—there are no levers, no complex linkages. For maximum accuracy, cams can be ground for you in our plant on numerically-controlled machines.

Two models, 308 and 312, rough, semifinish and finish a wide range of parts. Ask your Ex-Cell-O Representative for data, or write direct for details.

61-17M

EX-CELL-O FOR PRECISION

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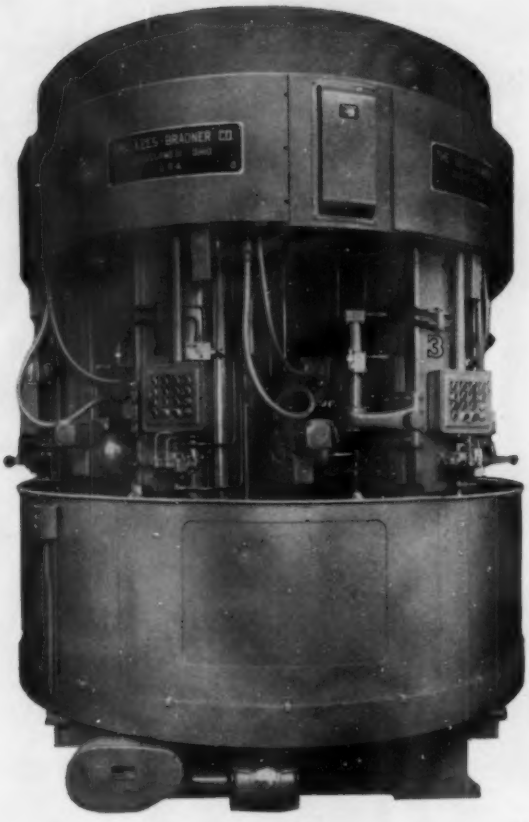
Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

LEES-BRADNER

Sets the HOBBING pace for tomorrow

with 6 machines in 1 . . .

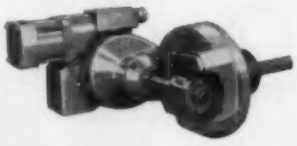


Lees-Bradner Model 7 HD 8″ x 20″ 6-Spindle Rotary Hobber. Also available in single and 4-spindle models.

Here's a complete hobbing production line in one space-saving unit. Actually the Lees-Bradner Model 7 HD 6-Spindle Hobber is six separate and independently operative machines in one. Each hobbing unit incorporates basically the same automatic, high-production features as the remarkable 7 HD Single Spindle Hobber. This includes a heavier, more rugged headstock, heavy-duty column and a 7½ H. P. motor on each spindle. This amazingly efficient machine not only saves valuable floor space but, with its pushbutton controls and automatic features, actually controls the operator thus reducing the chance for human error or slowdown. Chips and coolant are easily carried away from the headstock by the elimination of flat surfaces.

So, if your manufacturing space is valuable and high unit production important, ask your Lees-Bradner representative to give you the story on the ultra-efficient 6-spindle and 4-spindle rotary hobbers. Write or wire us direct for his name and address.

New 7HD HOB HEAD with 3½ inch hob shift. *Just dial it!*



IMPROVING GEARS . . . FOR 50 YEARS!

the LEES-BRADNER Company

CLEVELAND 11, OHIO, U.S.A.

LECTRA-FORM
Increases Production 500%

Ex-Cell-O Model 244 machines recess 5 times faster, with far lower tool cost!

Ex-Cell-O LECTRA-FORM Machines remove metal through high-current, low-voltage electrical spark discharge. Producing an inverse image of low-cost shaped rod, tubing or sheetmetal tooling, LECTRA-FORM accurately drills, pierces, trepans, slots, cuts or sinks intricate cavities in carbides and other conductive materials difficult or costly to machine by other methods.

Contact your Ex-Cell-O Representative for details, or write for LECTRA-FORM Bulletin 436014.

Model 244 has an electro-hydraulic servo for automatic tool feed and gap control, removes metal without distortion due to tool pressure. Inset photo shows part before and after 8-minute LECTRA-FORM machining.

HERE'S HOW LECTRA-FORM COMPARES TO CONVENTIONAL MACHINING

WORKPIECE Nickel-alloy aircraft part*	LECTRA-FORM MACHINING	FORMER METHOD
Tooling	Low-cost brass rod	Small end-mill cutter
Tool cost	Negligible	High wear and breakage
Accuracy	Uniform wall thickness	Distorted wall contour
Machining time	**8 minutes**	**40 minutes**

*Depth of recess approx. .080", wall thickness approx. 1/32".

61-30M

EX-CELL-O FOR PRECISION

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Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

NEW

KENDEX* Profiling Tool

...positively locked insert plus an adjustable chipbreaker

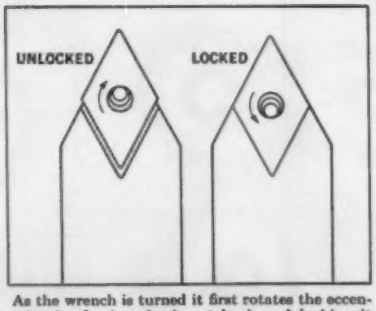
Now in one profiling tool you can get *both* of the latest design improvements. Another "first" from Kennametal Inc., the new Kendex Profiling Tool (A) securely holds inserts during normal cutting, back facing or contouring, and (B) permits a wide range of chipbreaker adjustment by simply turning a dial wheel.

The main design feature of this dramatically new Kendex tool is the eccentric pin that holds the insert securely in place. Positioned through a hole in the insert, this pin, plus the top clamp, positively eliminates any movement of the insert.

Just by turning the threaded dial wheel, the "Dial-A-Breaker" provides a wide range of adjustment of chipbreaker land width. Still another feature is the spring plunger that raises the chipbreaker when the clamp is released, making it easier to change, index or invert the insert.

Performance-proved on job after job over a period of months, the new Kendex Profiling Tool is now available from stock in three holder styles. The diamond shaped insert has a 55° nose angle, suitable for practically any profiling job. It is set in the holder at 5° negative side and back rake to provide four accurately indexable cutting points.

Get the complete story on this new profiling tool. Call your Kennametal Representative or write direct to KENNAMETAL INC., Latrobe, Penna.

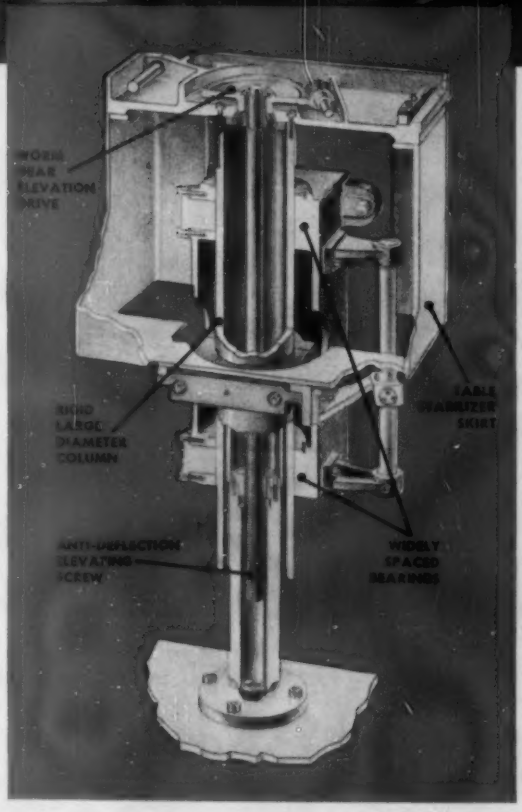


As the wrench is turned it first rotates the eccentric pin, forcing the insert back and locking it against two walls of the recess. Further rotation of the wrench locks the eccentric pin so that it cannot loosen during use.

*Trademark

33509

INDUSTRY AND KENNAMETAL
...Partners in Progress



Built by EX-CELL-O

To Insure Accuracy

Rugged, precision construction of Ex-Cell-O Contour Projectors results in stable support for the optical systems providing accuracy in the order of .0001″. This rigidity is a major consideration in achieving for Ex-Cell-O Projectors an outstanding record of trouble free operation and almost total elimination of down time.

Typical of the sturdy, precision workmanship to be found throughout Ex-Cell-O Contour Projectors is the worktable of the Model 14-5 and Model 30. Engineers will recognize the superior design features shown in the inset at right. To cite just a few, the large 5″ O.D. columns, supported in widely spaced bearings; the heavy channel skirt to stabilize the table assembly and the flexible elevating screw which can't impart deflections to the column.

Because of these construction features Ex-Cell-O Contour Projectors support heavy loads firmly, yet move easily and smoothly.

Whether your problem involves receiving, production or final inspection there's an Ex-Cell-O Contour Projector to do the job accurately, quickly and at low cost. The "why" and "how" is condensed in our new booklet—"43 Reasons Why Ex-Cell-O Contour Projectors are the First Choice of Industry." Yours for the asking!

Manufactured by EX-CELL-O Corporation at Detroit, Mich.

SOLD AND SERVICED BY

CP61-2

OPTICAL GAGING PRODUCTS, INC.

26 FORBES STREET ROCHESTER 11, N. Y.

Subsidiary of EX-CELL-O Corporation

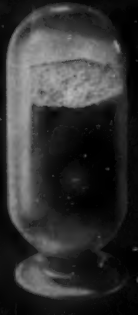
SIMONDS NEW RUBY WHEEL

TRULY DIFFERENT . . . FOR SUPERIOR GRINDING!

. . . and here's why.

RA . . . a new abrasive, new in appearance, new in grinding action. It's man-made rubies, a form of extremely friable crystalline aluminum oxide that cuts faster, stays sharp longer.

VB BOND . . . a completely new vitrified bond, the product of new materials and new firing techniques. Makes the Ruby Wheel a scientifically predictable cutting tool, always "on grade."



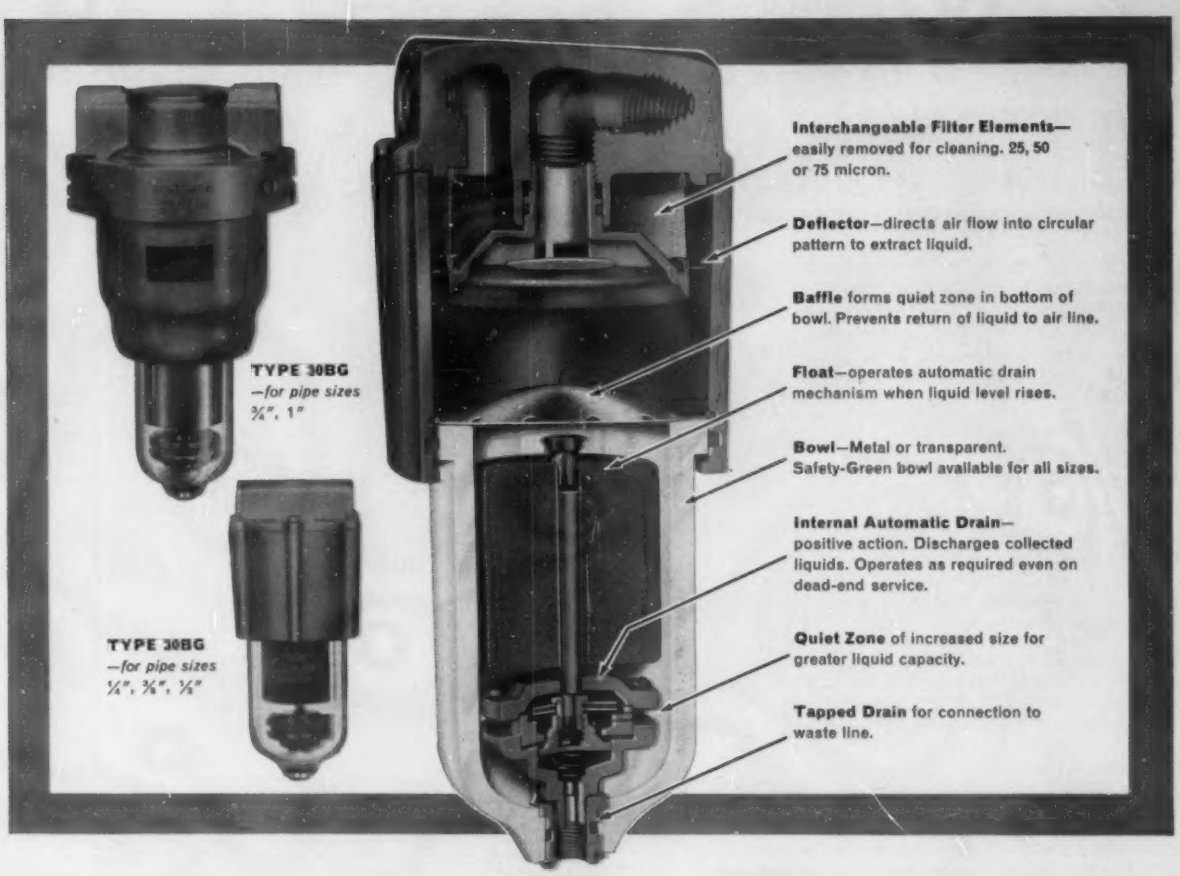
The big new forward step to abrasive machining! Outgrinds, outperforms other wheels . . . especially on the hardest toolroom steels including abrasion-resistant types. Incomparable for form grinding. Does a multitude of jobs with few specifications. Friable but tough to a degree never before attained . . . because of the radically different abrasive and bond combination.

Pick your toughest tool steel job and try the new Ruby Wheel. You'll find it a veritable "workhorse" for surface grinding, internal, tool and cutter and similar precision work. Ask your Simonds Distributor for details.

SIMONDS ABRASIVE CO.
PHILADELPHIA 37, PENNA.
DIVISION OF SIMONDS SAW AND STEEL CO.

your "buy-law" for better grinding
CALL YOUR SIMONDS DISTRIBUTOR
helping YOUR business is HIS business

WEST COAST PLANT: EL MONTE, CALIF. — BRANCHES: CHICAGO • DETROIT • LOS ANGELES • PHILADELPHIA • PORTLAND, ORE. • SAN FRANCISCO SHREVEPORT — IN CANADA: GRINDING WHEELS DIVISION, SIMONDS CANADA SAW CO., LTD., BROCKVILLE, ONTARIO • ABRASIVE PLANT, ARVIDA, QUEBEC


TYPE 30BG
—for pipe sizes
¼", 1"
TYPE 30BG
—for pipe sizes
¼", ⅜", ½"
Interchangeable Filter Elements—easily removed for cleaning. 25, 50 or 75 micron.
Deflector—directs air flow into circular pattern to extract liquid.
Baffle forms quiet zone in bottom of bowl. Prevents return of liquid to air line.
Float—operates automatic drain mechanism when liquid level rises.
Bowl—Metal or transparent. Safety-Green bowl available for all sizes.
Internal Automatic Drain—positive action. Discharges collected liquids. Operates as required even on dead-end service.
Quiet Zone of increased size for greater liquid capacity.
Tapped Drain for connection to waste line.

Norgren Automatic-Drain Compressed-Air-Line Filters provide FULL-TIME protection

The purpose of a compressed-air-line filter is to remove liquids and solids from the air-stream so that they cannot clog, corrode or damage air-powered equipment. Your equipment needs this protection *full-time.*

Manual drain filters are often neglected . . . are not drained as often as they should be. When excess liquid collects in the bowl these filters no longer do the job. Liquid in the air-stream passes right on through to your air tools, cylinders and other air-operated equipment.

This cannot happen with Norgren Automatic-Drain Filters. They empty themselves as often as required . . . never get too full. Operation is determined entirely by the need for draining; and not, as with some makes, by changes in air pressure. Although an automatic-drain filter costs more than a manual drain filter, Norgren Automatic-Drain filters protect your air-powered equipment *full-time* day and night, year-in-year-out. They prevent costly wear and damage to your equipment and eliminate man-hour costs for manual draining.

Order Norgren Automatic-Drain Filters from your nearby Norgren Representative, listed in the telephone directory—or write factory for catalog.

FOUNDED IN 1925

C. A. NORGREN CO.

3447 SOUTH ELATI STREET, ENGLEWOOD, COLORADO

A STOCK LEMPCO DIE-SET HELPED H. K. METALCRAFT DO THE "IMPOSSIBLE"!

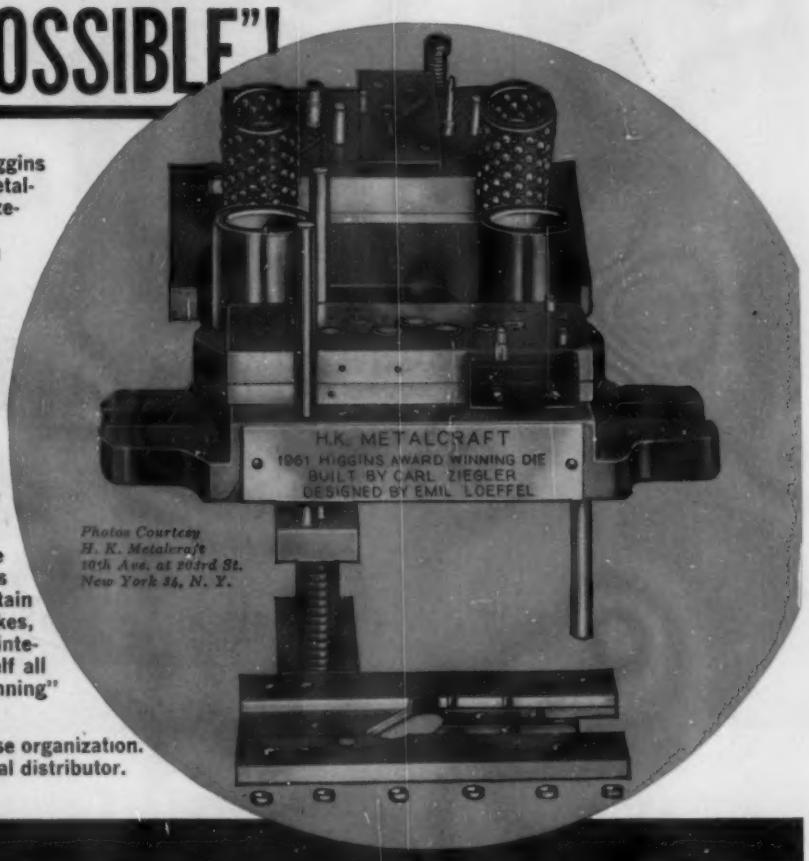
Winner of the John Woodman Higgins Award for 1961, Emil Loeffel, Metalcraft tool engineer, mounted his prize-winning dies in STOCK Lempco Die Sets, assembled to his order by a N. Y. City Lempco Distributor; see photos.

These dies produce, at $1.75 per thousand, a part which formerly cost $12 per thousand.

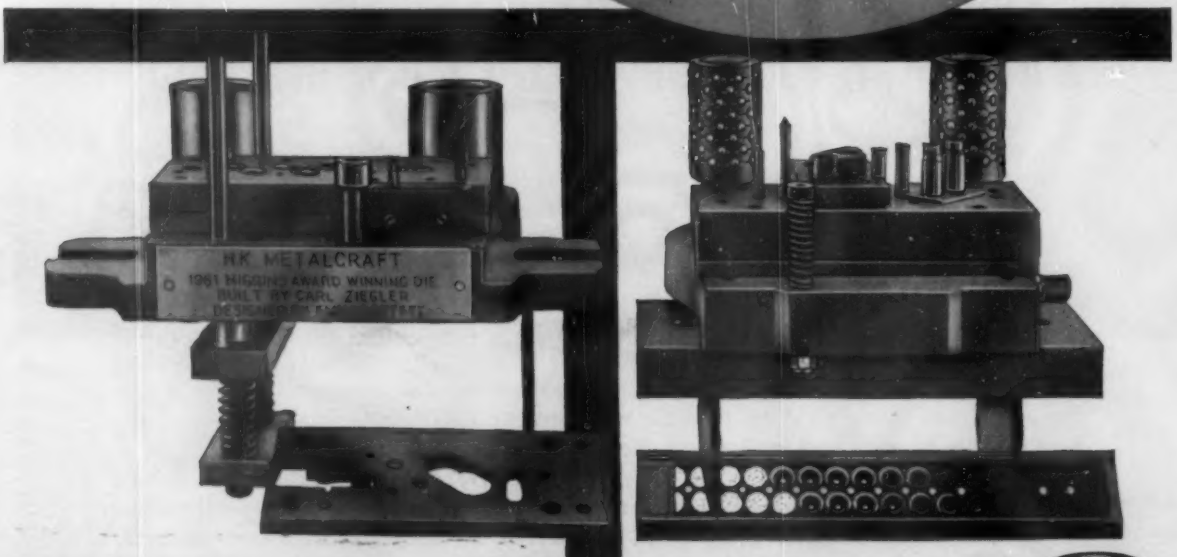
It was no accident that Lempco Die Sets were selected; Mr. Loeffel says he trusts their accuracy completely and adds, " . . . time saved in assembly and disassembly is very considerable".

Lempco Ball Bearing Precision Die Sets have long been known for this feature and for their ability to maintain exact alignment for millions of strokes, with an absolute minimum of maintenance. Why not find out for yourself all the advantages of using "prize-winning" die sets?

Lempco has a nation-wide warehouse organization. Write for literature and name of local distributor.



Photos Courtesy H. K. Metalcraft 10th Ave. at 203rd St. New York 34, N. Y.



LEMPCO INDUSTRIAL, INC.

Subsidiary of LEMPCO PRODUCTS, Inc. • Other Operating Subsidiaries: LEMPCO INTERNATIONAL, Inc. • LEMPCO AUTOMOTIVE, Inc., Automotive Parts Division • EVANS REAMER & MACHINE • Tractor Division

Bedford, O. Telephone GReenwood 5-2400

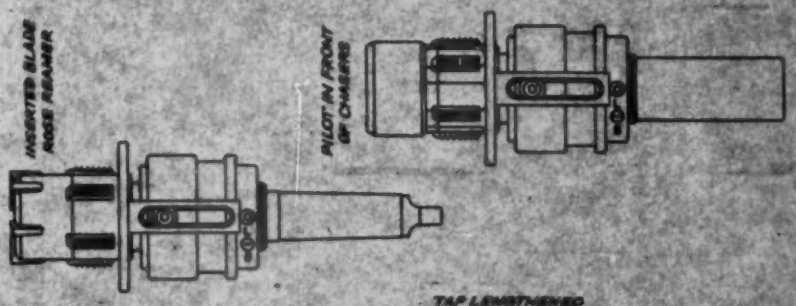
Use Reader Service Card, CIRCLE 36

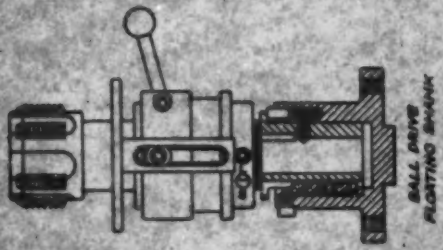
Use Reader Service Card, CIRCLE 37

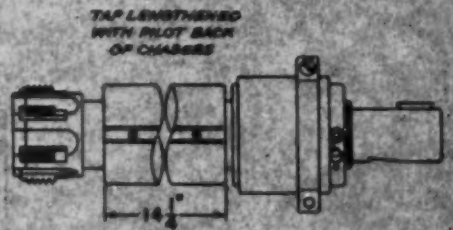
The three adaptations of the Regular "S" Collapsing Tap illustrated here make it the most versatile stock Tap you can find anywhere.

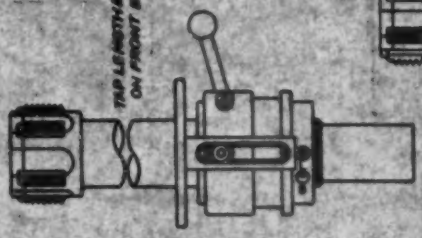
BUT that's not all!

HERE ARE A FEW SKETCHES SHOWING SOME SPECIAL ADAPTATIONS WHICH HAVE BEEN FURNISHED FROM THE BASIC "S" DESIGN. WE HAVE HUNDREDS MORE IN OUR FILES WE'D LIKE TO SHOW YOU



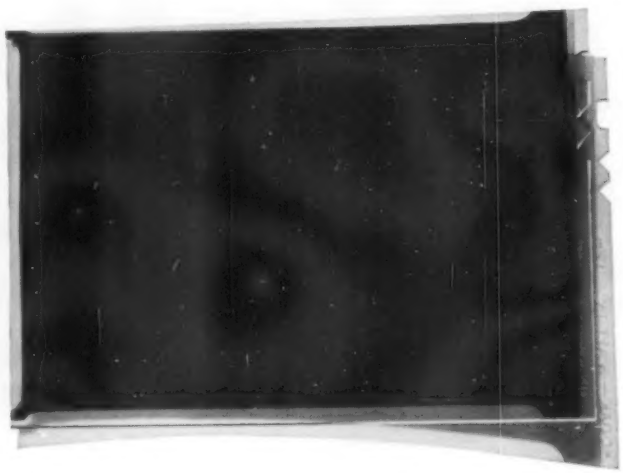






IF YOU HAVE ANY TAPPING JOBS IN THE 1 5/16" TO 8" RANGE IT WOULD PAY YOU TO INVESTIGATE 'S' TAP ADAPTABILITY

GEOMETRIC TOOL CO.
NEW HAVEN 15, CONN.



This is a picture of the job we did for Hamilton Standard

It wasn't easy. Although we've designed and built lots of very special *precision* rotating components — for spinning molten glass, for routing bagasse, for driving magnetic "memories," and for doing dozens of other exotic things — we had never built one of these. For that matter, neither had anyone else. Hamilton Standard worked very closely with us. We modified their designs, and they modified ours. Then Whitnon's super-machinists built the darn thing, and it's a great success. Works even better than the specifications. We're dying to show it to you, and tell you all about it, but we promised we wouldn't same as we would promise you. So where does that leave us, and where does it leave you? If you have a special problem in rotating machinery, let's talk about it. But don't invest a lot of time and money in your own shops first. Talk with experts. Talk with Whitnon. *Now.*

The Whitnon Manufacturing Company, Farmington, Connecticut

Whitnon

Growing Up

This year, for the first time, your Society passed the 41,000 member mark. Certainly the phenomenal growth of the Society is one index of success.

We should not forget, however, that sheer growth in total membership is *not* a primary objective of ASTME. Service, not size, is the Society's reason for being. Growing up implies that the Society must take on increased responsibilities, it must grow in its ability to serve members and industry.

Like any youth, your Society is growing up in a changing world. The past decade has seen more evolution in engineering than any comparable decade in history. And the Sixties, uncertain as they are in many respects, will certainly bring new challenges to tool and manufacturing engineers everywhere.

As a part of the growing up process, your Society must continue to adapt itself to the changing needs of members and of industry: Needs for up-to-date engineering information on new developments. Needs for greater numbers of well-qualified tool and manufacturing engineers. Needs for leadership in keeping America the strongest industrial nation on earth, regardless of the boasts of dictators.

Your Society believes in planned growth, as exemplified by the studies and recommendations of the Long Range Planning Committee, which amount to a blueprint for progress. And yet that blueprint, like any blueprint, means nothing until some engineer processes the job and puts it into production.

Where Society growth is concerned, that engineer is *you*. Your Society is depending on you for the hard work—this year, next year and the year after—that will help to further the Society's over-all program for the economic growth of America.

Your personal investment in progress will pay rich dividends. Taking on new responsibilities you will find that you will do some "growing up" yourself, that you grow in maturity and judgement and in happiness—the happiness that results from a hard job well done.

The opposite of growth is stagnation. The best way to keep from stagnating is to get out of a do-nothing rut and help ASTME and yourself move smoothly down the highway toward a more productive future.

People—and societies—who have "go," grow!

W. Moreland

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Quick guide to toolroom requirements

DRILL ROD

Carbon Steel Drill Rod—A high-grade drill rod with smooth finish and extreme size accuracy.

Ry-Alloy® Drill Rod—Non-deforming . . . excellent finish, accurately sized, free from decarburization.

Ry-Alloy Ground Flat Stock—Accurately ground on all four sides. Ends and sides are square, parallel, and accurate to dimension. Free of surface decarburization . . . spheroidize-annealed for best machinability.

TOOL STEELS

Ry-Alloy Tool Steel—An oil-hardening steel. Combines high hardness and deep hardness penetration with minimum distortion, freedom from cracking. Good machinability.

V.D.® Tool Steel—An all-purpose, water-hardening carbon vanadium steel. Easy to machine . . . hard and tough after heat treatment. Hardening characteristics permit wide variation in treatment with uniformly good results.

V.D. Chisel Steel—A specially developed, water-hardening carbon molybdenum tool steel ideal for hand and pneumatic chisels.

Tool Steel Sheets—Rolled from high-grade tool steel of about 1.00% carbon. Smooth, blue finish protected by oil. Can be hardened in oil or water; quenching medium depends on hardness desired. 27 gauge up to 3/16″ thick.

AISI-E 6150—For impact applications. Provides relatively high surface hardness while retaining strength and toughness throughout the cross section.

Carbon Steel Plate—All sizes and thicknesses.

E-Z-Cut® Plate—Remarkable free-machining qualities make this plate ideal for die bases, jigs, rubber molds, etc. Up to 30% savings in machining time compared to ordinary steel—with approximately 50% increase in tool life.

Complete heat-treating information is furnished with each shipment of Ryerson V.D. or Ry-Alloy Tool Steel.

ALLOY STEEL PLATE

4140 Plate—An oil-hardening, annealed plate of firebox quality. Specially developed for maximum strength and uniform hardenability throughout the cross section. Thicknesses from ¼″ through 5″.

E 8615 and 8620 Plate—These oil-hardening, case-hardening alloys are ideal for flats, rings, discs and irregular shapes. Accurately flame-cut to your order.

Cold Finished Bars—A wide range of analyses. Rounds to 10″; squares to 4″; flats to 12″ x 2″.

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controlling costs with statistics

By O. William Irving
Quality Assurance Director
Fancher Furniture Co.
Salamanca, N. Y.

Production costs can be controlled and stabilized at low levels through the use of statistical analysis. The method employed is essentially the same as that used for quality control.

THE ECONOMIC USE of machines, material and manpower can be controlled as easily as the quality of the products which are being processed. Statistical quality control has demonstrated that effective graphic presentations enable management to pinpoint quality problems and thus maintain adequate control of quality. It has also been found that this statistical approach to quality control can be just as effectively utilized in the control of budgetary expenditures. This enables quality-control departments to offer additional services to management through use of a readily available tool—the $\bar{p}$ chart.

In $\bar{p}$ charts the presence of inherent variables determines the reliability of a given unit or the quality level of a given process. In similar manner, a variation in the utilization of manpower determines the over-all effectiveness and resultant cost of the operation of any segment of production. Where performance of a unit or process fails to conform to a prescribed pattern, an assignable cause can be found to account for this lack of conformity. In like manner, when overhead costs in a plant or department fail to conform to prescribed patterns, the same principles will apply and assignable causes can always be found. Because of this, it is possible to apply the $\bar{p}$ chart to budgetary problems.

Budgetary Control Systems: Most plants have a manufacturing budget which prescribes or forecasts reasonable burden cost expenditures. For those plants which do not have such systems, the following outline may prove useful.

The first requirement is a common denominator —a given figure in any production activity that can be used as a base for considering the relative level of any given burden or overhead expenditure. In most cases the direct-labor expense is a suitable denominator. Through use of this factor, fluctuations in business volume are equalized and proportionate variations in other expenditures can be isolated. This is accomplished by applying the fundamental $\bar{p}$ chart, *Fig.* 1, to budgetary control through substitution of dollar values for the unit values which are normally used. The basic figure, corresponding to the sample or lot size on a $\bar{p}$ chart for fraction defective, will be the direct-labor dollar value on a $\bar{p}$ chart for budgetary control.

Manufacturing Budget

Account Classification	Expense ($)	Direct Labor (%)
Indirect Labor	50	5.0
Excess Labor	75	7.5
Rework Labor	40	4.0
Setup Labor	120	12.0
Inspection	30	3.0
Material Handling	80	8.0
Downtime	20	2.0
Miscellaneous	85	8.5
Total Burden	500	50.0
Total Direct Labor	1000	100.0

Fig. 1. Manufacturing budget showing classification of accounts and corresponding expenses.

The second factor, corresponding to the defective units on a $\bar{p}$ chart for fraction defective, will be the dollars actually spent for the expense on which the $\bar{p}$ chart for budgetary control is being constructed. The expenses that are compared or related to direct-labor cost should be under the direct or indirect control of the same individual or group that controls the direct labor expenditure.

For example, a department foreman might be responsible for the following expenditures:

1. **Indirect Labor**—Time or dollars spent that contribute directly to completion of the product but cannot be allocated on a measurable basis to each unit of any particular product
2. **Excess Labor**—Time or dollar differential between a direct-labor employee's wages and a guaranteed rate when the employee has not produced the minimum quantity required by piecework
3. **Rework**—Time or dollars spent in repairing or reworking parts or units to make them conform to dimensional specifications
4. **Setup Labor**—Time or dollars spent for machine changes or tool adjustments not included in direct labor
5. **Inspection Labor**—Time or dollars spent in obtaining reasonable assurance of proper adherence to specifications
6. **Material Handling**—Time or dollars spent in transferring material to the department or from station to station within the department, exclusive of time allowed for direct labor
7. **Downtime**—Time or dollars spent during which an employee must be paid for idle time for which he is not responsible
8. **Miscellaneous**—Other accounts which might be grouped together or considered separately include checkers and time clerks; supplies; repairs and maintenance; tools, dies and molds; supervision; material; power; insurance; and engineering.

The dollar volume in each of the established ac-

STATISTICAL CONTROL WORK SHEET

Week Ending	Direct Labor ($)	Expense ($)	Direct Labor (%)	Deviation (3σ)	Lower Control Limit	Upper Control Limit
April 11	1000	80	8.00	2.57	5.62	10.76
April 18	1100	85	7.73	2.41	5.78	10.60
April 25	900	75	8.33	2.76	5.43	10.95
May 2	1150	70	6.09	2.12	6.07	10.31
May 9	950	90	9.47	2.88	5.34	10.04
May 16	1050	95	9.05	2.66	5.53	10.85
May 23	1230	100	8.13	2.34	5.85	10.53
May 30	1075	120	11.16	2.88	5.31	11.07
June 6	950	65	6.84	2.46	5.73	10.65
June 13	1100	80	7.27	2.35	5.84	10.54
Total	10,505	860	8.19			

Fig. 2. Statistical-control work sheet. Values of 3-sigma determine both control limits.

counts will correspond in statistical application to the number of defective units on a regular $\bar{p}$ chart. Therefore, values of $\bar{p}$ can be determined by dividing expense by direct labor.

In this way the equation for $\bar{p}$ can be written:

$$\bar{p} = \frac{\text{budget expenditure}}{\text{direct labor}}$$

For all practical purposes this equation is the same as that used in quality-control departments.

A simple departmental budget for a given week might appear as shown in TABLE 1. The data for establishing a control chart for the material-handling account might then appear as shown in *Fig.* 2.

Control Limits: Average expense, an equivalent of the process average, is 8.19 percent. The same statistical approach can be applied to make the calculations for the process or expense control chart as shown on *Fig.* 2. This is done by first establishing the value of 3σ, the standard deviation from normal, and then subtracting 3σ from the value of $\bar{p}$ to obtain the lower-control limit (LCL). The value of 3σ added to $\bar{p}$ provides the upper-control limit (UCL). These values can then be charted to obtain the graph illustrated in *Fig.* 3.

Calculation of 3σ is accomplished with the formula

$$3\sigma = \frac{3\sqrt{\bar{p}(1-\bar{p})}}{\sqrt{L_D}}$$

in which σ = deviation; $\bar{p}$ = direct-labor percentage; and L_D = direct labor in dollars.

Using 8.19 percent as the value of $\bar{p}$, it is possible to obtain over-all limits by evaluating the square root of L_D and substituting this value in the formula for 3σ. Direct labor equals \$10,505 for a period of 10 weeks so average direct labor equals \$1050.50. Therefore

$$L_D = \$1050.50$$

$$\sqrt{L_D} = \$\ 32.41$$

By substitution:

$$3\sigma = \frac{3\sqrt{0.0819\ (1-0.0819)}}{32.41}$$

$$3\sigma = 2.54 \text{ percent}$$

By addition of this value to $\bar{p}$, an upper-control limit of 10.73 percent is obtained. Subtraction of 2.54 from $\bar{p}$ results in a lower-control limit of 5.65 percent.

In the graph, *Fig.* 3, the burden expense appears to be in control except in the eighth week. In the fourth week a low point occurs when direct labor increases and expense decreases. Conversely, the high or out-of-control point which occurs in the eighth week results when direct labor decreases and expense increases. Steps can then be taken to minimize the excessive costs.

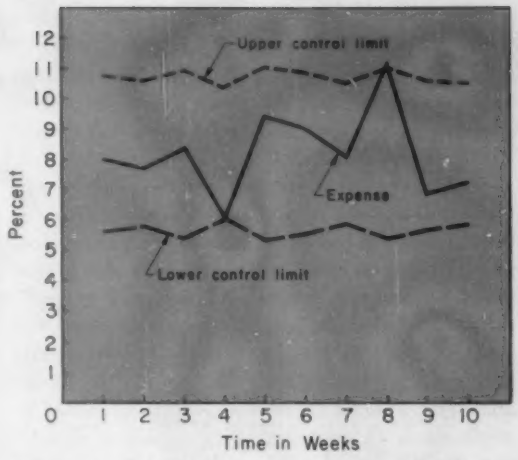


Fig. 3. Cost-control chart showing control limits. Out-of-control point is indicated in the eighth week when expense exceeds upper control level.

Continuous Graphs: Through use of the 8.19 percentage factor as a process average or expense average, the $\bar{p}$ chart can be used indefinitely to control budget expenditures. However, just as the quality control chart is often intended and used as a starting point for improvement of quality, the $\bar{p}$ chart for budget expenditures can and should be used as a starting point for reduction of overhead or burden costs. The data, followed with periodic reviews of the statistics and tests for significant change, will eventually lead to reduction of the expense average and possible compression of the control limits.

In most cases, however, another factor which enables management to reduce costs can be utilized. This factor is the allowable or desirable figure which is established as a goal of performance in each expense area. As an example, the desirable percentage in *Fig.* 3 might arbitrarily be established as 5. Average expense, however, is 8.19 percent. Consequently, management expects a reduction of 3.19 percent in the cost of direct labor. The desirable figures are usually arrived at after extensive study of performance in similar areas, consideration of conditions in the subject area and simple economic necessity. If desirable allowances have not been established, the quality-control engineer can usually estimate allowances by taking the average of the best eight of the previous twelve months or the best ten of the previous thirteen weeks. Another method of obtaining desirable allowances is by elimination of the few high or out-of-control points from the available data.

After a desirable figure has been established, it is possible to construct lines of regression which provide for reduction of expenses to the desired points. This is accomplished by computing control limits from the desired expense allowance. Desired

percentages are substituted for $\bar{p}$ and new control limits are calculated. Thus, if 5 percent instead of 8.19 is used for $\bar{p}$, the formula produces a value of 2.02 percent for 3σ. This enables management to establish new upper and lower control limits of 7.02 and 2.98 percent.

Desired expense averages and corresponding control limits should be established at a meeting between interested personnel. This meeting is exploratory, its purpose being to determine the spread that exists between the actual and desirable expenditures. It should be recognized at this time that some variation in the expenditure is expected and provided for. In addition, the source of the desirable figure and the need for its attainment should be emphasized. A second meeting, within a day or two, should then be arranged at which time the desirable limits can be entered on the control chart, *Fig.* 4.

At the second meeting, an estimate should be made of the time required to reduce the expense to the desired level. Lines of regression can then be drawn on the chart *Fig.* 5 to indicate the progress that must be made to meet the target date. Lines of regression and theoretical performance where the expense has been reduced are shown in *Fig.* 5.

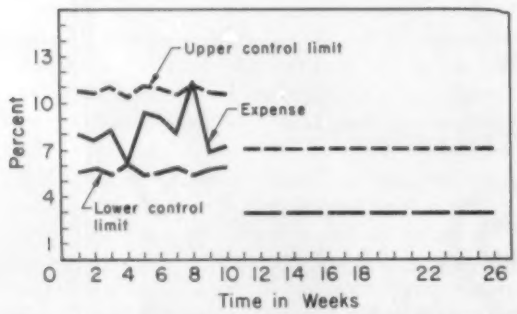
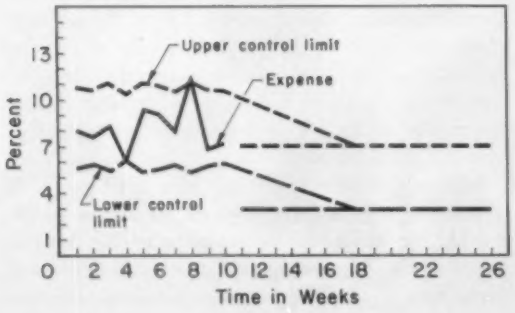


Fig. 4. Control chart with desired control limits added. These are established by assigning new production averages.

Fig. 5. Lines of regression added to the chart. Slope of lines is arbitrary and depends on estimated time to arrive at desired levels.



Excessive Expenditures: A statistical consideration in the construction of $\bar{p}$ charts for budgetary expenditures that would not normally occur in the construction of a $\bar{p}$ chart for fraction defective arises when expenses are in excess of 50 percent of the direct labor. For example, the cost of setup labor in a short-run department or job shop might be $300 for a week as compared to $150 in the same week for direct labor—in which case the expense is 200 percent of the direct labor. Occurrences of 50 to 500 percent and more are not uncommon in some applications. When this happens, the formula for computing the 3-sigma factor cannot be used because it involves the square root of a negative number. When the formula is used, the maximum solution with $\bar{p}$ equaling 50 percent could be 1.50. However, when $\bar{p}$ is greater than 50 percent, values for 3σ can be found through use of its value at 50 percent. This value—obtained by dividing the percentage by 50—is multiplied by 1.50, its value at 50 percent. The resulting product is a factor which can be substituted for the radical in the numerator of the formula. Therefore, when $\bar{p}$ is greater than 50 percent, equation values may be adjusted accordingly. For example, if $\bar{p}$ equals 60 percent, values for 3σ become

$$3\sigma = \frac{(60/50)\,(1.5)}{\sqrt{L_D}} = \frac{1.8}{\sqrt{L_D}}$$

Summary: Good starts in controlling costs through statistical anaylsis can be made by utilizing available data covering all burden charges. To do this effectively the following procedure is recommended:

1. Data should be gathered on all accounts such as re-operation labor, inspection, spoilage and waste. It can readily be seen that changes in the labor force, product, production errors and other assignable causes affect these accounts and cause fluctuations
2. Lines of regression should be drawn on the basis of existing or calculated desirable allowances
3. Experiments with available data on other burden expenses should be made to determine whether costs are in line, whether they fluctuate beyond statisical control limits, and whether this systematic statistical approach to cost reduction could result in substantial savings
4. Studies should be made to determine which accounts in various departments throughout the plant are the cause of greatest excess expenditures. Usually about ⅓ of the total number of accounts will account for approximately ⅔ of the total excess expenditure
5. Control charts should be set up for a period of twenty-six weeks on the basis of an eight or ten-week base period.

Proper presentation of this data and information provides an excellent tool for reducing expenditures in production. Its most desirable benefit is that it enables supervision at all levels to contribute more directly to the economic operation of a company.

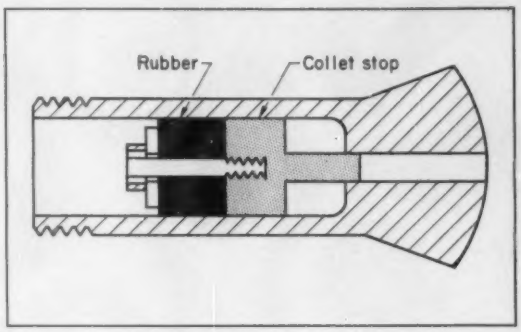
Gadgets

Ingenious Devices And Ideas

Rubber Locks Collet Stop

Heavy rubber can be utilized to lock a collet stop in place for production turning operations. The stop, shaped to workpiece requirements, is machined to a slip fit in the collet. A rubber drum is then machined to the same diameter and screwed to the stop. Expansion of the rubber—and consequent locking of the stop—is effected by tightening the screw against a washer.

Ralph Whitney
Framingham, Mass.

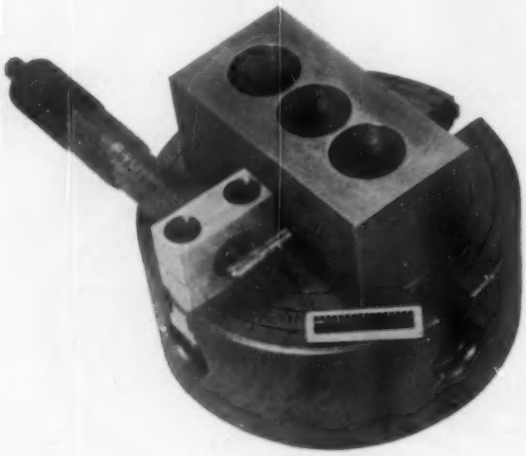


Altered Pipe Center Supports Large Parts

Tubular parts that require turning on a lathe can be supported with a conventional, but altered, pipe center. Alteration is accomplished by tapping holes and inserting hex-head screws in the collar. The center is then advanced into the workpiece and the screws are adjusted to place the workpiece on the axis of the lathe.

H. J. Gerber, Member-at-Large, Stillwater, Okla.

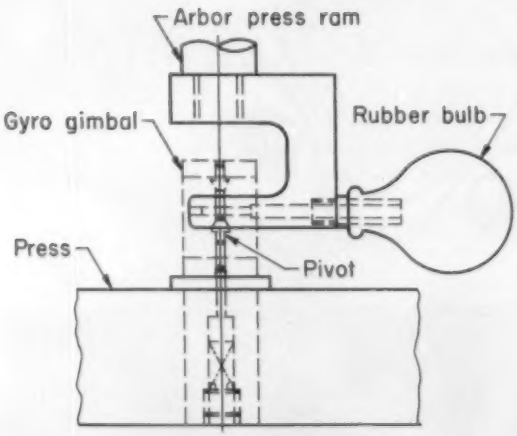
Gadgets



Precision Boring Head Made From Standard Chuck

Conversion of a conventional chuck to an inexpensive boring head can be accomplished by removal of the jaws and insertion of the special block illustrated. Boring bars are held in any of the three holes in the block. Screws to keys in the chuck, this block can be adjusted by loosening the screws and making desired corrections with the attached micrometer.

C. Gibbons
Greenwood, N. S.



Air Pressure Aids Assembly

Parts-handling difficulties in arbor-press assembly of small pivots to gyro gimbals are overcome by the special adapter illustrated. Positioning of the pivots is accomplished with a small cavity machined to part configuration. Parts are held in this cavity by differentials in air pressure caused by evacuation of a rubber bulb.

Norman E. Carlson
Riverside Chapter

YOU HAD A GREAT IDEA!

Remember that clever gadget you developed to solve a tough production problem? Or that tricky tool or die design that eliminated one or more operations? It was an excellent idea and you probably received recognition for it. Why not let it continue to work for you as an entry in the 1961 Gadgets Contest? Just write a brief description—in your own words—and send it in with a simple sketch conveying your idea to the Gadgets editor of THE TOOL AND MANUFACTURING ENGINEER.

- **Prizes** — One first prize of $100, two second prizes of $50 and four third prizes of $25 will be awarded. Also, numerous honorable mention awards will be made with each recipient receiving a copy of *The Die Design Handbook* or *The Tool Engineers Handbook*.
- **Judging** — All entries will be judged by your National Editorial Committee on the basis of originality, conciseness and completeness.
- **Contest Dates** — **October 1 to December 31.**

PRODUCTION DRILLING for short-run lots

By Harry Conn
Chief Engineer
Scully-Jones and Co.
Chicago, Ill.

Low unit costs of high-production methods are obtainable for short-production runs if proper techniques are applied. The author discusses factors involved and their evaluation.

PERHAPS the most difficult of all manufacturing problems is to know how to intelligently adapt high-production techniques to low-production quantities and still be economically correct. Engineers want the low unit cost obtainable from high-production techniques. Often they think they do not have sufficient quantities to justify the tooling expenditures. In reality, there are thousands of short-run jobs that can be run on high-production equipment and obtain drastic unit cost reduction. A good illustration involves the application of a multiple-spindle drill head to a single-spindle drillpress. A more involved and financially attractive application involves the use of multiple-spindle machines and cluster plates such as employed in the battery of Natco machines in *Fig.* 1.

To obtain the low unit cost advantages of high-production techniques when producing low quantities, several factors are characteristically involved:

1. Job lots must be repetitive. The lower the setup cost, the lower the economic lot size will be and therefore, the more frequent the runs.
2. Job change-over must be short. This includes all cutting tool changes, adjustments, jig and cluster plate removals, and installments.
3. Several or perhaps many jobs must be run using the same machine, thereby increasing ease of economic justification of capital equipment.

It is necessary to understand the effect of setup on unit cost and the effect that proper amounts of tooling have on unit cost. Whether a drill or adapter costs $1 or $100, it must pay for itself in a definite period of time. The same is true for the machine. Low cost can be obtained from high-production techniques when performing drilling, reaming, tapping, counterboring, core drilling, re-

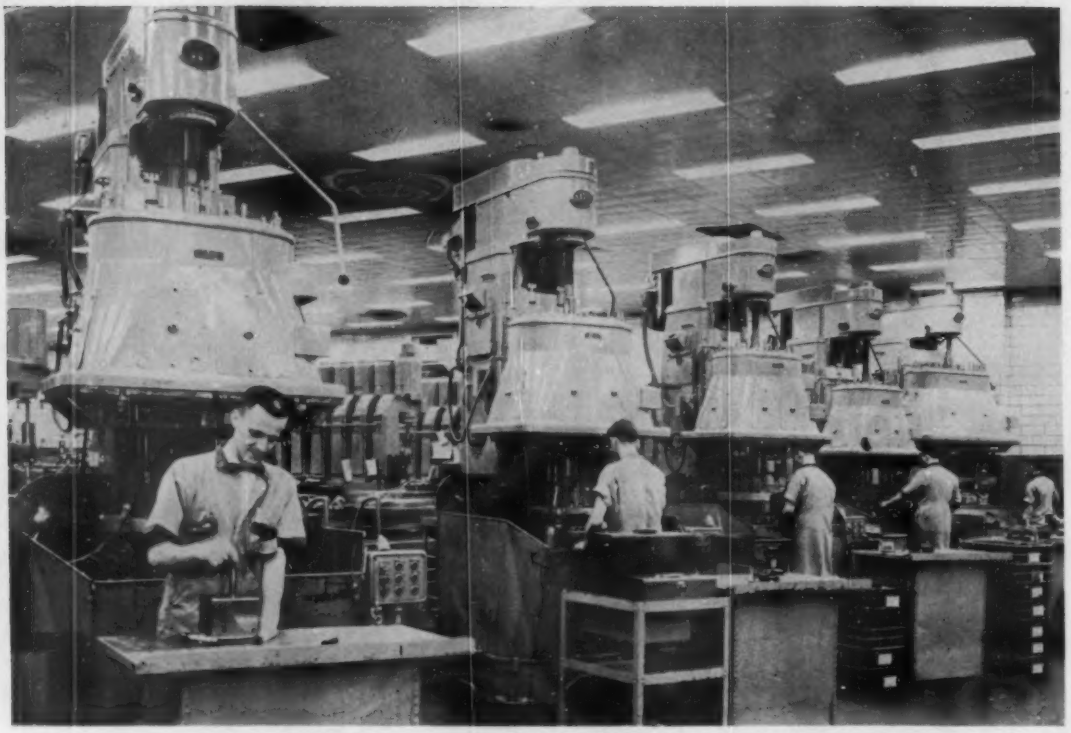
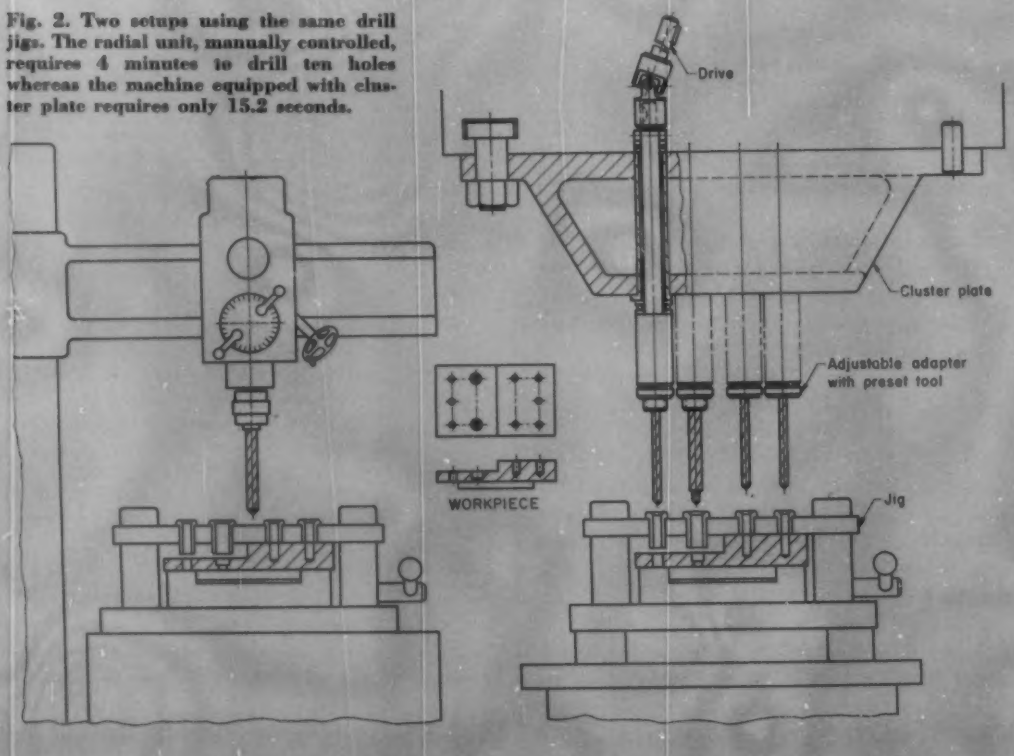


Fig. 1. Multiple-spindle drilling machines using cluster drill plates with preset tools to minimize unit costs.

Fig. 2. Two setups using the same drill jigs. The radial unit, manually controlled, requires 4 minutes to drill ten holes whereas the machine equipped with cluster plate requires only 15.2 seconds.



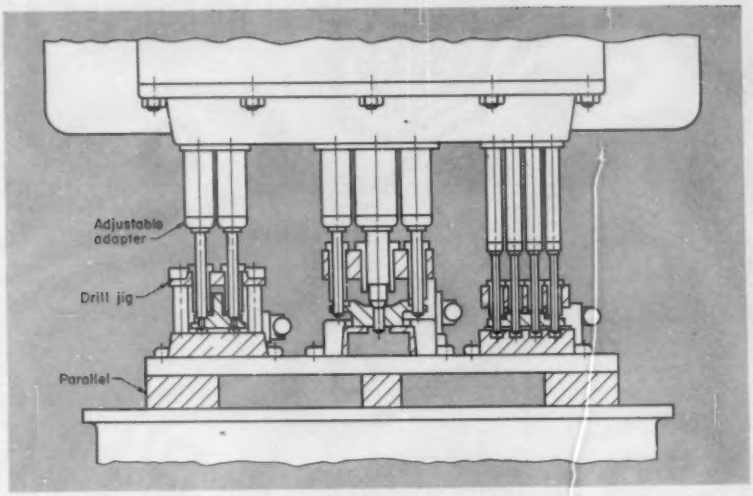


Fig. 3. For short runs on small parts cluster plates may have setups for three jobs to reduce piece costs.

cessing, chamfering and spotfacing operations.

The part being drilled in the machine in *Fig.* 2a has 10 holes, requiring a total machining time of over 4 min per part. *Fig.* 2b shows the same job on a multiple-spindle drill, using a cluster plate and the same jig. The total machining time at the same feeds and speed is 15.2 sec. This is a savings of 4 min per part with many human factors eliminated, such as holding of depth, engaging and disengaging of feeds, changing speeds, tool changing, head moving, etc.

The multiple-spindle machine shown in *Fig.* 3 shows three different jobs being run at the same time. In other words, when one of these is changed, all three are changed. To change this job setup takes less than one hour. That includes, insert forks of a lift truck between the parallels on the table, unclamp plate on which the jigs are mounted, run head down, put blocks under drill-cluster plate between plate and head, unloosen five capscrews, run machine head up and, with fork truck, take jig and cluster plate to storage.

To install a setup, the jig and cluster plate are placed on the table of machine. Head is run down within a short distance from the top of the cluster plate. Dowels and dowel holes between machine head and cluster plate are aligned. Then cluster plate is clamped to the head. Jig-mounting plate is clamped to the machine table. After the spindle couplings of machine are connected to the cluster plate spindles and feed dogs are set, the job is ready to run.

All of the various depths of the tools shown in the sketches are set when the one depth stop on the machine is set because the drills, counterbores, reamers and their adapters are never removed from their cluster plate unless a dull tool is replaced.

Fig. 4. Typical adjustable adapter toolholder for presetting tool.

A casting or part may have holes to be machined on four different faces; therefore, it is possible to have four different holding fixtures or jigs on the same base plate and the corresponding number of spindles needed for each face in the same cluster plate. The cluster plates are usually made of cast iron or aluminum. An adjustable adapter holds the cutting tools and provides for depth adjustment, *Fig.* 4. The adjustable adapter makes possible the use of many taper combinations and straight-diameter shank cutting tools in one slip spindle.

If more than one job is run in a cluster plate, care must be taken in choosing the correct position of the spindles so that each spindle will have a driver that does not cause the universal joint to work at too great an angle.

This method of job change-over has the advantage over the conventional adjustable multiple-spindle drill because:

1. Spindles are prepositioned.
2. No individual spindle depth adjustment is needed during setup.
3. Tools are not removed, inserted or adjusted.
4. When more than one job can be run in a cluster plate, two setups are obtained for the price of one.

The economics of the tooling can be computed readily. Jig cost is practically the same as that for a conventional drill jig with the additional cost of the mounting plate and leader pins. The slip spindles which include spindle sleeve, thrust bearing, washer, nuts and key, start at $32 per spindle for the smallest

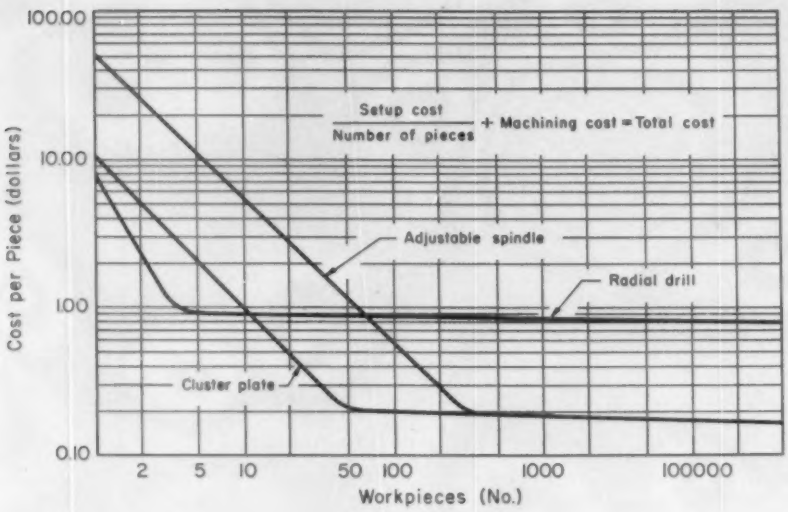


Fig. 5. Setup economics show how costs for a typical job compares for three different methods of hole drilling.

sizes. Adjustable adapters range in cost, nut included, from $4.40 to $11.55. The cost of changing the complete setup after the job has been run once, should be computed on the basis of one hour of time.

Whether a radial drillpress, a multiple-spindle machine with removable cluster plates or a multiple-spindle adjustable bracket type machine is employed is a matter of economics. Setup costs for comparison are charted in *Fig.* 5. Machine-hour values for the three methods are computed at $10 per hour. The example plotted shows that the cluster plate type of setup is the correct selection for quantities between 13 and 300 pieces for this particular job. The cost of the cluster plate divided by the savings per run is equal to the number of production runs necessary to pay for the cluster plate. Depending on the complexity of the drilling requirements each job will show a different amount of savings at various quantities. Nevertheless, if some tools must hold depth dimensions and if many spindles are needed, the curves will remain similar.

Navy Develops Discriminating Shock Tester

Several peak shock-recording devices that can isolate and record amount as well as type of shock have been developed by the U. S. Navy. The devices are attached to prototype weapons to determine the magnitude of shocks received when the weapons are dropped during ruggedness tests. Covering a shock range from 30 to 20,000 times the pull of gravity, the devices are accurate in excess of 80 percent for simple shock pulses.

Called discriminating copper-ball accelerometers, the devices were developed by the Environment Simulation Division of the Naval Ordnance Laboratory in Silver Spring, Md. Each device consists essentially of a copper ball, weight, anvil and housing encased in a sliding collar. As a result of a shock impulse, the copper ball is deformed as the weight forces it against the anvil. Comparisons of the measured deformation of the ball with deformation data obtained under static tests show the magnitude of the shock.

During water-entry drop tests, weapons may experience multiple shocks in close time sequence such as impact when hitting the water, drag through the water and contact with the bottom. In these cases, the discriminating accelerometers can isolate and record the initial shock of impact as well as the second or final shock, depending upon which has the greater value.

Another model of the accelerometer is designed to discriminate against an initial shock and record only the final jolt. When this model receives an initial jolt such as that produced by water entry, a restraining block is forced clear of the heavy weight allowing it to come to rest on the copper ball. Upon impact of the final jolt, the copper ball is deformed to record the magnitude of the shock.

The new discriminating copper ball accelerometers do not solve all the problems incidental to shock recording. However, they are expected to serve a useful purpose until a technological breakthrough reduces the cost and size of continuous shock-recording instruments now under development.

OPTICAL TOOLING
solves alignment problem

By W. J. Mariner
Quality Control
Clark Bros. Co.
Olean, N. Y.

Parts that are too large for checking on a surface plate with mechanical measuring devices can be quickly and accurately inspected by optical methods. The author shows how optical tooling insures correct alignment in the manufacture of a 5500-hp natural gas engine.

CHECKING of large parts that have stringent accuracy requirements often presents difficult measurement problems. This was the case at Clark Bros. during construction of a 16-cylinder V-type natural gas engine rated at 5500 hp. The cylinder block was about 29 feet long and 8½ feet wide, with 24 ½-inch diameter bores for cylinder liners.

Quality control and inspection departments were faced with the problem of checking the squareness relationship between the cylinder bores and the bottom of the block. This feature was especially critical. Unless the axis of the crankshaft and the centerline of the cylinder bores of an engine are square within close limits, engine wear could be excessive.

Squareness could have been checked with the block mounted on a machine tool; however, Clark engineers were reluctant to base critical measurements on the assumption that a machine was in perfect alignment and decided to develop a more positive measuring method. Because of the size of the part, inspection on a surface plate was out of the question. A combination of bars, mandrels and indicators might have been used, but it was considered to be of doubtful accuracy.

Optical equipment seemed to be the best choice. Clark Bros. had some optical equipment already on hand for use in the alignment of machine tools. Engineers from companies that specialize in optical tooling were called into consultation to determine the best methods and equipment for the job at hand.

After considering the geometry involved, it was determined that three features had to be established: the crankshaft centerline, the centerline of each cylinder bore and planes perpendicular to the crankshaft centerline.

Crankshaft Centerline Check

In engine assembly, *Fig.* 1, the bottom of the cylinder block lies parallel to the crankshaft centerline. A series of alignment lugs in the bottom of the cylinder block serve to assure the necessary parallelism in a lateral direction. It was decided to use these surfaces as reference planes to locate the crankshaft centerline.

The block was placed upside down on eight heavy screw jacks, which were adjusted to get the bottom of the block flat. Flatness of this surface was read by mounting an alignment telescope on one corner and then taking a series of readings on a target moved along the surface, *Fig.* 2. The surface could have been leveled, but flatness was all that was actually required.

Fixtures were made that mounted on the flat surface and were located laterally by the alignment lugs. Bores in the fixtures were located on a centerline between the alignment lugs and at a specified distance from the bottom of the cylinder block. This distance was such that the bore centers were on the crankshaft centerline. The diameter of the bores was a close fit on a standard 2½-inch-diameter alignment target.

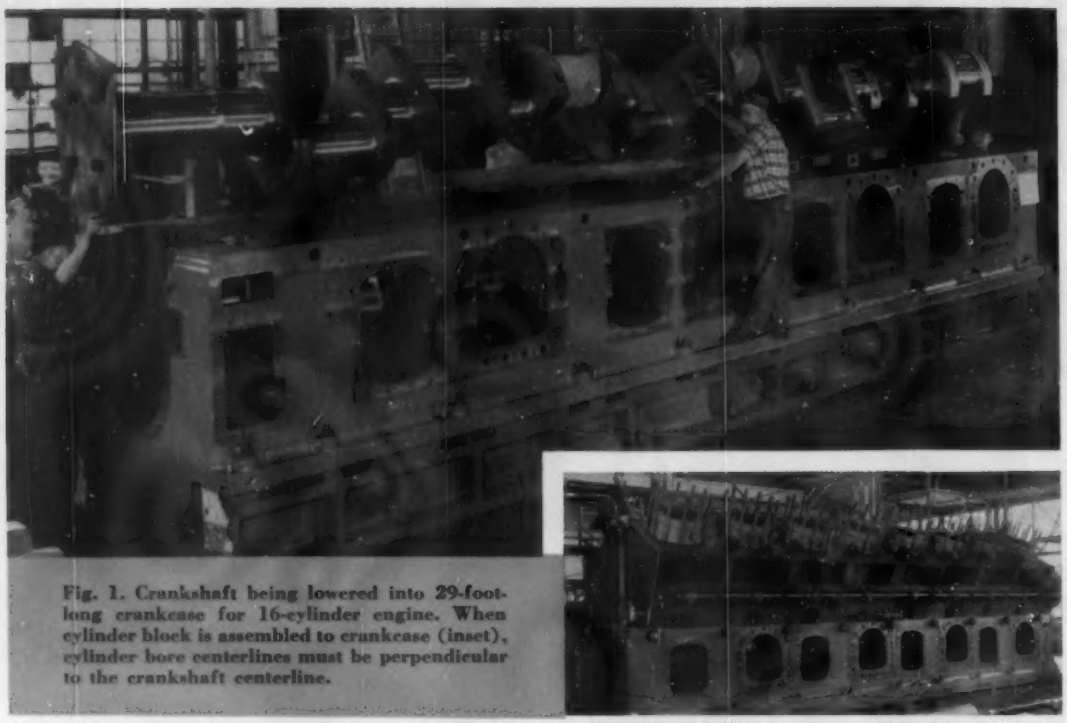


Fig. 1. Crankshaft being lowered into 29-foot-long crankcase for 16-cylinder engine. When cylinder block is assembled to crankcase (inset), cylinder bore centerlines must be perpendicular to the crankshaft centerline.

One of the fixtures was placed near each end of the block so that each target defined a point near one end of the crankshaft centerline. The two points determined the crankshaft centerline. In order to establish a line that could be used, an optical alignment telescope was aligned on these two points. Due to the focal length of the instrument, it was necessary to mount it about six feet away from the first target, which was of the open cross-hair type. Sightings could be taken through this target to the second target, wich was of the glass paired-line type. These targets and the telescope were left in position during the entire checking operation.

Having three points in line, it was possible to periodically check to see if any one point had been disturbed. With the telescope in position, the crankshaft centerline was established and could be extended to any desired length beyond the instrument. After the telescope was bucked in, the accuracy of the target carrying fixtures was checked by reversing them and taking optical micrometer readings to measure any differences.

Cylinder Bore Centerline Check

To establish the centerline of a cylinder bore, targets were mounted in each end of the bore. Standard target-carrying spiders were used, with extra-long extensions. These spiders had a micrometer centering device so that the target could be accurately positioned in the bore center regardless of any taper or variation in bore size. An open cross-hair target was used in the spider closest to the crankshaft centerline; a glass paired-line target in the spider farthest from the crankshaft centerline.

In order to set up planes perpendicular to the crankshaft centerline, an alignment telescope with built-in optical micrometers was placed on a standard telescope bracket and mounted on a fixture approximately at the crankshaft centerline. This fixture did not have to be highly accurate, since the telescope mounting bracket had fine horizontal and vertical adjustment.

The telescope was aligned parallel with the crankshaft centerline that was already established with the first telescope. To obtain this parallel alignment, the principle of collimation was applied. Both instruments were set on infinite focus and the second telescope adjusted to pick up and center the cross hairs of the first. The lines of sight from both telescopes are parallel, although not necessarily coincident, when this method is used. Adjusting the telescope is much easier than bucking-in on two points and obtaining a common line of sight for both telescopes. During alignment, both telescopes must be at infinite focus. After alignment, either telescope can be focused as desired to take readings.

With the alignment telescope in position, the next step was to mount an optical square in front of the telescope. The optical square, which consisted of a pentaprism, was designed so that it could be

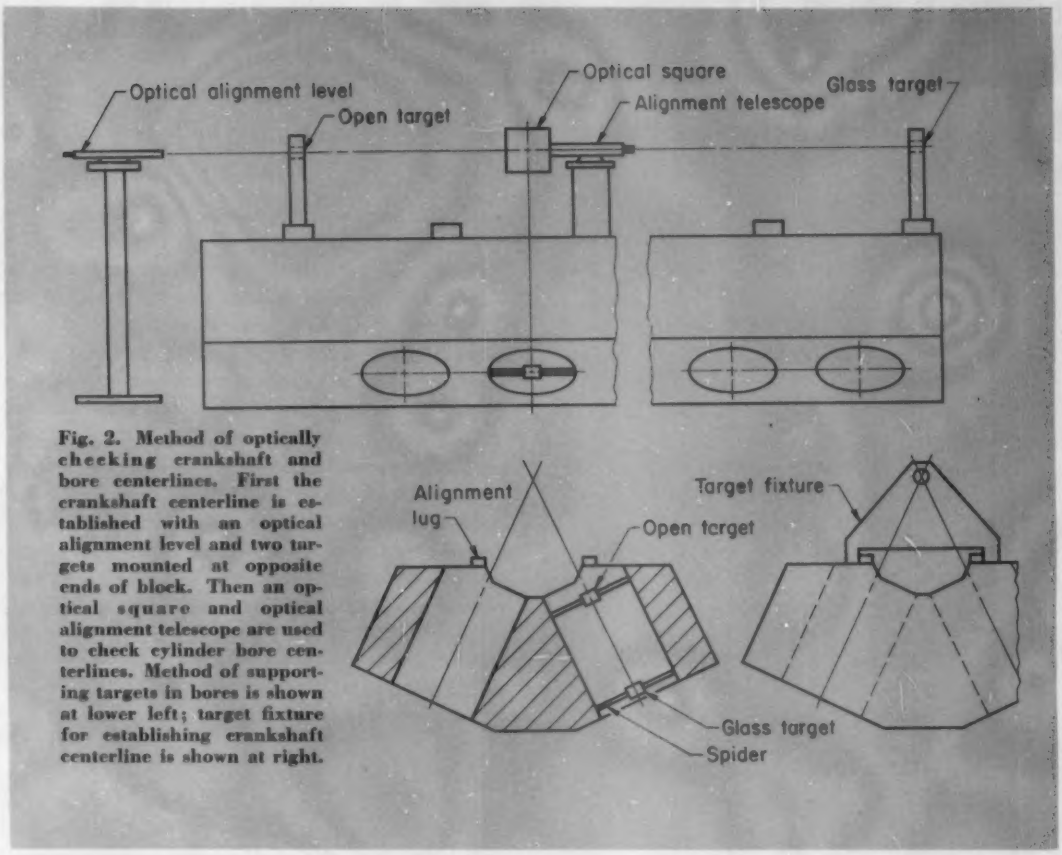


Fig. 2. Method of optically checking crankshaft and bore centerlines. First the crankshaft centerline is established with an optical alignment level and two targets mounted at opposite ends of block. Then an optical square and optical alignment telescope are used to check cylinder bore centerlines. Method of supporting targets in bores is shown at lower left; target fixture for establishing crankshaft centerline is shown at right.

accurately attached to the front of a standard 2¼-inch-diameter telescope and was constructed so that it was possible to check the original line of sight as well as to sight at 90 degrees from the original line of sight. Since that line of sight was parallel to the crankshaft centerline, a plane perpendicular to the crankshaft centerline was established.

By moving the entire assembly—telescope, optical square, mounting bracket and fixture—along the cylinder block in an axial direction, it was possible to set up and sweep a plane at, or close to, the centerline of each cylinder bore. This axial position had to be close enough to the cylinder bore centerline so that the optical micrometers in the telescope could be adjusted to obtain readings on the targets mounted in the cylinder bore. The telescope was re-aligned each time the assembly was moved.

Readings obtained on the two targets mounted in the cylinder bore told the position of the target relative to the plane swept by the optical square. If one target read +0.008 inch, for example, and the other read +0.009 inch, the bore was tipped 0.001 inch in the length between the targets.

After the targets in one bore were read, they were moved to the corresponding cylinder in the opposite bank of the block. The optical square was rotated to sight through the new bore and readings taken as before. The next step was to take readings from the next pair of cylinder bores. On the 16-cylinder engine, eight setups of the optical square and its telescope were required and sixteen setups of the two targets used to obtain the centerlines of the individual cylinder bores.

Successful application of optical tooling for this job has convinced Clark Bros. engineers that optical methods offer a degree of accuracy that cannot be attained with more conventional methods. The block was checked by direct measurement and centerlines were set up from the part itself with a minimum of special tooling. At no time during the checking was it necessary to tie up an urgently needed machine for on-the-machine checking, nor was it necessary to assume the accuracy of a machine tool that may or may not have been properly aligned or maintained.

An added advantage of optical checking is that it provides measured data for product design engineers. This data can be correlated with the performance of the engine during testing. The correlation provides a sound basis for determining what tolerance limits must be used in the future.

designed for

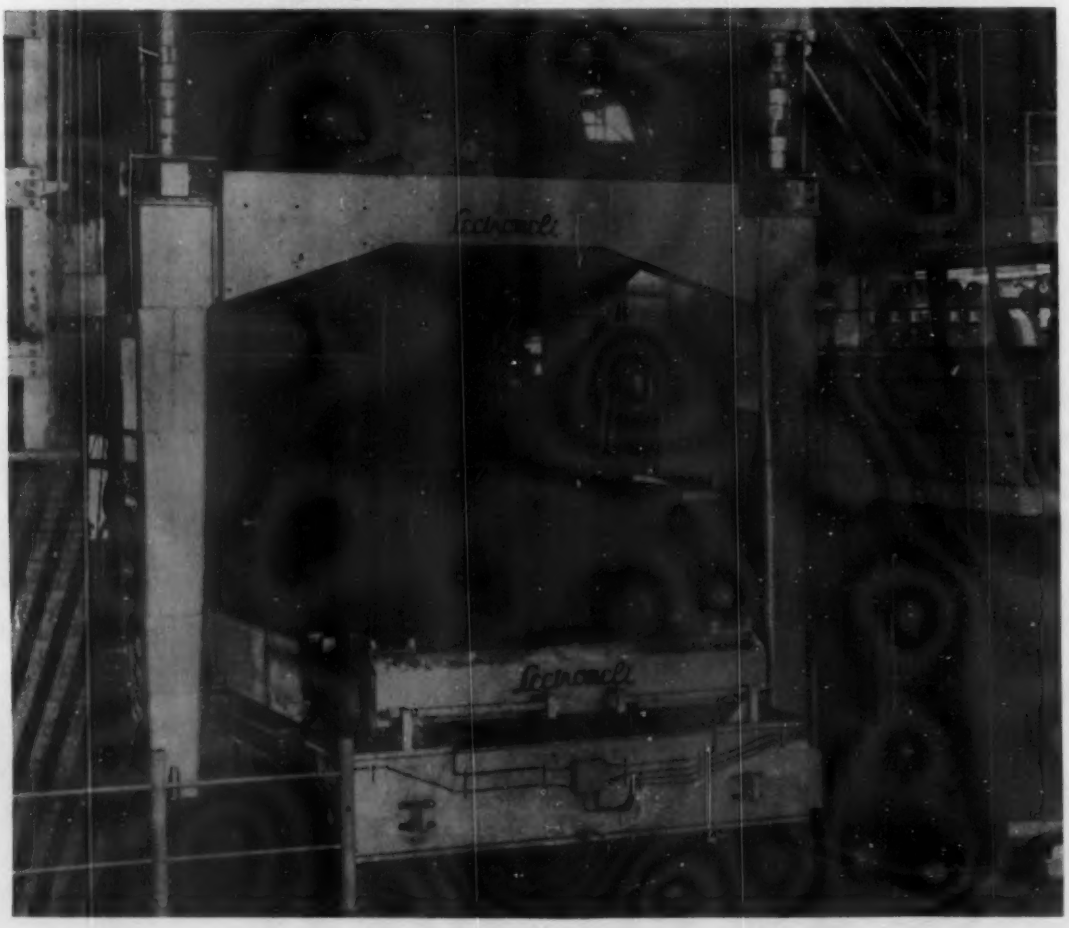
PRODUCTION

Degassing Unit Processes Steel In Vacuum

Gas removal from steel, a process previously accomplished by induction melting and vacuum-arc remelting, is obtained on a high-production basis with this unit. A second feature of the unit—addition of alloying elements under vacuum—makes it possible to eliminate the oxidation that normally accompanies alloying operations.

First step in degassing is accomplished when a suction nozzle or "snorkel" is inserted into a ladle of molten steel. The vacuum vessel from which the snorkel is appended is evacuated and then lowered a predetermined distance into the ladle. This causes the steel to flow up through the snorkel into the vacuum vessel under atmospheric pressure. Because

LADLE positioned under degassing unit. Snorkel is visible in down position at the center of the ladle.



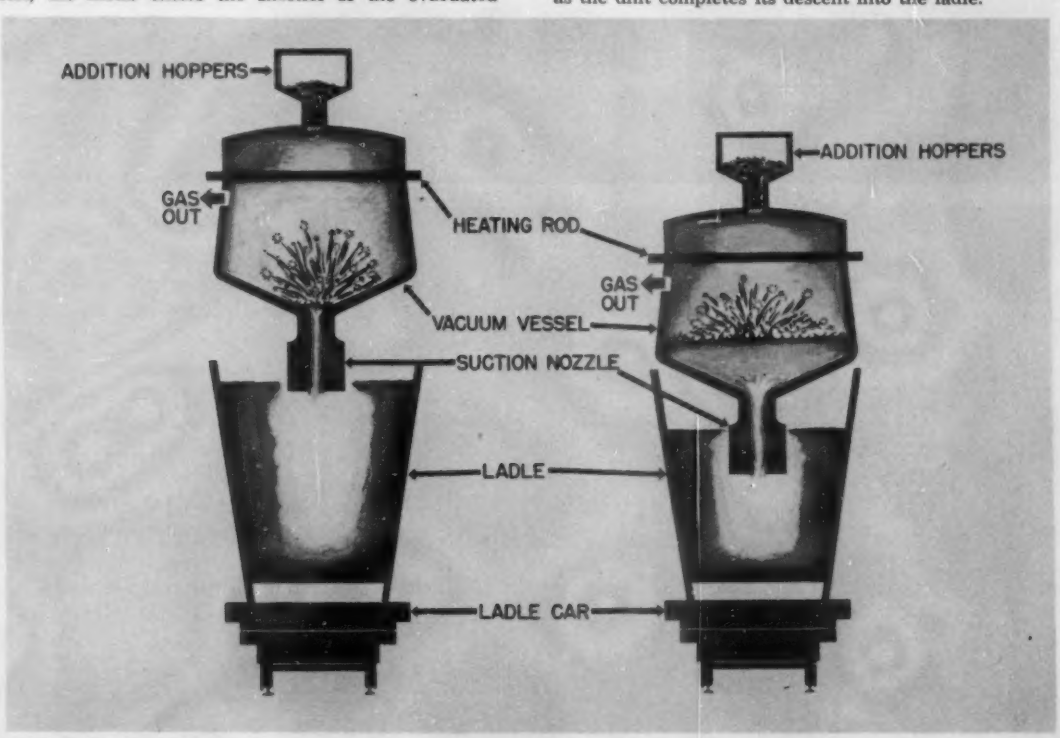
the metal is in a highly turbulent condition, its gases are released and removed by the evacuation system. The vessel then raises and the degassed metal flows back to the ladle. This steel, heavier as a result of degassing, settles to the bottom of the ladle and a cycle is complete. Each cycle treats approximately ten percent of the metal in the ladle, but 32 cycles are made to insure maximum effectiveness of the operation.

After degassing is completed, carefully estimated amounts of alloying additives enter the vacuum vessel at each cycle. Because only a relatively small amount of additive is introduced, it is possible to sample the metal during this operation and make any necessary corrections in additive flow.

Designed by Dortmund-Horder Huttenunion of Dortmund, West Germany, this unit is installed at Crucible Steel's Midland, Pa. plant. It was built by Lectromelt Div. of McGraw-Edison Co., Pittsburgh, under a licensing agreement with the Dortmund Co.

DEGASSING UNIT at work processing a heat of steel. Measurements of gas extraction and alloy content are taken in control room at right.

SCHEMATIC DIAGRAMS of action in degassing unit. At left, the metal enters the snorkel of the evacuated vessel. At right, the metal enters the evacuated vessel as the unit completes its descent into the ladle.

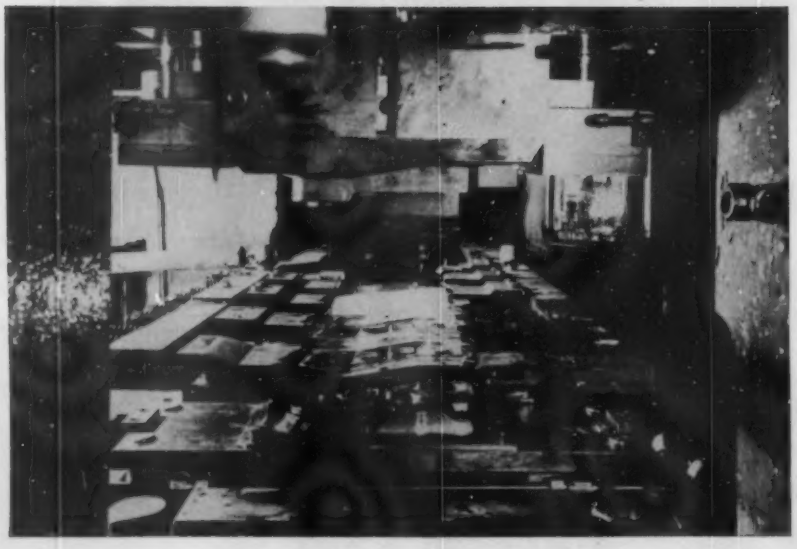


Forge Press Utilizes Transfer-Die Techniques

Forge operations are now accomplished with transfer-die techniques at the AmForge Div. of American Brake Shoe Co. The progressive transfer die through which the work is advanced is a four-stage unit incorporating two blockers, a finisher, and a trim and coining station. Because the work is advanced mechanically, the forging die is built with the accuracy of a progressive die.

In operation, the transfer unit is actuated by the reciprocating movement of the press. As the billet enters the die area, it is gripped by fingers on the transfer rails and advanced to the first station. As the press closes, the transfer bars supporting the fingers withdraw, clearing the die area. After die closure, in which the first blocking action takes place, the bars re-enter the die area, seize the part and advance it to the next station. This cycle, worked in conjunction with the press cycle, is repeated until the finished part emerges from the press and is removed by conveyor.

TRANSFER BARS in operation. During upward ram movement, unit enters die area, seizes parts and advances them one stage.



A PROGRESSIVE forging die. Bars and fingers are visible at either side of the die.

GRINDING FLUIDS

part 3—their selection and use

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Selection of suitable grinding fluids may depend not only on their effects on grinding action but also on their behavior away from grinding contact, as well as on the manner of application.

GRINDING FLUIDS are conveniently grouped in two categories: their own stability with respect to physical or chemical changes and their effects upon everything with which they may come into contact.

Stability: A soluble oil should not invert from an oil-in-water emulsion to a creamy water-in-oil emulsion which has poor cooling properties and will gum up a wheel. This can result from improper preparation of the emulsion or from the use of too high a concentration of soluble oil in water. The oil should always be added to the water and mixed thoroughly, otherwise inversion may take place. In many cases, it is helpful to first prepare a rich emulsion, containing at least six or seven parts of water to one of oil, to which more water can be readily added to give the desired concentration.

Cold water is generally satisfactory but in some instances hot water may be required if the emulsion is to be stable. Either inversion or the formation of a separate layer of oil on the surface may occur if the water is too hard. It is then necessary either to soften the water or to use a soluble oil designed specifically for hard water.

As was pointed out previously, a high concentration may markedly improve the grinding action of a water-base fluid but to take advantage of this the emulsion must remain stable in use at the desired concentration. Whatever the initial concentration may be, it will change with time, since some oil is carried off on the work, and water evaporates both in use and while the machine is idle. The concentration should be checked periodically so that it can be maintained at the desired strength.

Bacterial growth is another source of instability in soluble oils. It can cause formation of corrosive agents and sludge even before any strong odors are developed. Bacteria can originate in the water supply itself, especially if it contains dissolved sulfur-bearing mineral compounds, as well as from external contaminants such as food particles or skin infections. Since bacteria grow in water, chemical fluids are not necessarily immune. Grinding oils, on the other hand, do not normally provide a suitable medium for the propagation of bacteria.

Germicides can be incorporated in the concentrated soluble oil or can be added to the diluted emulsion, but their effectiveness in controlling bacterial growth is limited by the nature of the product to which they are added and by the amount of germicide that can be added without giving rise to skin irritations. One way of controlling the bacterial problems is to clean the coolant system periodically with a germicidal cleaner that is also designed to remove any caked deposits where bacteria are likely to breed. With a central system, bacterial growth and the resultant odors during machine shut down can be minimized by continuously pumping and aerating the fluid.

Chemical fluids of the nitrite-amine type can decompose to give off ammonia when aluminum or certain varieties of cast iron are ground. In severe cases, the gas may be given off so rapidly that the fluid appears to be boiling. Improper storage conditions, involving excessive heat or cold, also cause deterioration of water-base products, particularly soluble oils.

Foaming may occur with water-base fluids high in wetting agents, particularly when the operation entraps a great deal of air, as in disk grinding or in

abrasive cutting off. A fluid formulated for use with hard water may foam excessively when mixed with soft water because the latter is free from the hard-water ingredients that prevent foaming. Defoaming agents such as certain silicones can be added to the fluid to eliminate this type of instability.

Although a fire hazard is always associated with the use of a grinding oil, most fires start because oily swarf has been permitted to accumulate in the system and not because the oil mist is ignited by the spark stream. The latter can take place if the oil happens to contain volatile constituents so that its flash is relatively low, but most commercially available grinding oils have a high enough flash point to keep the mist from igniting except under unusual conditions.

The combination of hot sparks and an accumulation of oil-soaked swarf can lead to a dangerous fire because both the oil and the fine metallic chips will serve as fuel once a fire gets started. Except that the swarf becomes ignited by a hot spark, the phenomenon is essentially similar to the spontaneous combustion of oily rags, which starts at a lower temperature. Thus the prevention of fires when grinding with an oil is primarily a matter of good housekeeping.

Influence on Wheel Condition: A grinding fluid may adversely affect the grinding action by weakening of the wheel bond. Vitrified bonds are not affected by immersion in grinding fluids but organic bonds may be seriously weakened. Resinoid and shellac bonds are softened slightly by plain water, but not enough to make any practical difference if the water is at room temperature. Alkaline solutions, however, may soften and weaken these bonds appreciably, the magnitude of the effect increasing with the concentration and the temperature. It is not possible to correlate softening with degree alkalinity because the nature of the alkaline compound can be an important factor. Also, some lubricity and detergency additives have their own undesirable effects.

Other factors include the permeability of the wheel, the particular type of bond and its volume percentage in the wheel, the size and shape of the wheel, and the length of exposure to the fluid. Thus a thick, dense wheel will be affected little by an alkaline compound that would cause a serious weakening of a thin and comparatively porous wheel. Similarly, a cutoff wheel that would deteriorate when exposed over a period of time to this type of fluid will not be affected if used in a production operation. Because the extent of which the wheel may be affected by the fluid depends on so many factors, only trial or previous experience will tell whether a certain grinding fluid will be satisfactory in this respect.

Silicate bonds are also softened by alkaline solutions but rubber bonds are not. However, the latter may be softened to a pronounced extent by grinding oils and by soluble oils as well.

Another aspect of the wheel condition that can be influenced by the grinding fluid is the cleanliness of the wheel face. Gumming results from the deposition of sludge or of a water-in-oil emulsion, either of which may contain abrasive fines and grinding chips. A heavy deposit of such material between the abrasive grains will reduce their cutting effectiveness and will increase the amount of heat generated. Circulation of sludge can be prevented by suitable settling and filtering equipment and by following a periodic cleaning schedule. The formation of a water-in-oil emulsion can be prevented by proper mixing and by avoiding too high concentration for the product involved. It is particularly important to keep the wheel face clean in operations involving a large contact area between the wheel and the work, and the high detergency types of chemical fluids are often used in such circumstances because they are the most effective in this respect.

Prevention of Corrosion: Two important properties of grinding fluids, which have already been discussed, are their cooling ability and transparency, either or both of which may be sacrificed if improved grinding action is required. Another important function is to prevent corrosion both of the work and of the equipment. Any water-base fluid can cause rusting unless effective inhibitors are

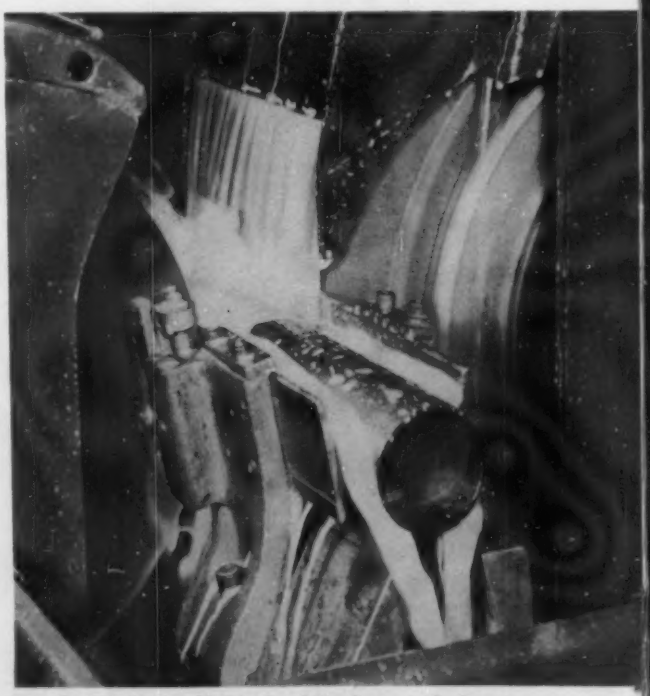

Fig. 1. Work should be flooded when stock is removed at a high rate, as in centerless grinding.

present. A soluble oil emulsion leaves a protective film of oil on the surface provided the emulsion is not too dilute. This can result from depletion of the oil phase through its being carried off on the work, or from trying to economize by using a considerably lower concentration than recommended.

In the latter case, the operation presumably does not call for the moderate degree of lubricity associated with the recommended concentration of the soluble oil, and it is much better to reduce the cost of the fluid by using a dilute solution of a nitrite-amine rust inhibitor, which still provides chemical protection against rusting. Since this is a true water solution, it is a more effective coolant than an oil-in-water emulsion. These or other chemical rust-inhibiting agents are added to some soluble oils to furnish even greater protection by the formation of both a chemical and a physical barrier to oxidation. The effectiveness of a rust inhibitor depends also on the nature of the material being ground, cast iron and malleable iron requiring greater protection than steel.

Corrosion can manifest itself not only as ordinary rusting but also as pitting or as staining. In grinding with soluble oils, both pitting and staining are occasionally observed on surfaces in contact with each other for a considerable period even though surfaces over which the grinding fluid is permitted to flow freely are not affected in this manner. Trapping of a soluble-oil emulsion as a stagnant film between two surfaces can cause it to deteriorate and result in corrosion. Staining and pitting are not restricted to this type of condition but may result from the inherent incompatibilty between the fluid and the work material or from the gradual deterioration of the fluid during continued usage. For example, grinding oils containing active sulfur are not used in connection with copper or copper-base alloys because they would turn black. If water is permitted to get into a grinding oil containing chlorine, traces of hydrochloric acid may form and cause corrosion.

Chip Settling: Grinding fluids may vary considerably in their ability to keep chips and abrasive fines from recirculating. This is an important consideration when a particularly good finish is desired, since loose particles are likely to leave scattered, easily visible short scratches (often called fishtails or digs) in an otherwise smooth surface. Recirculating chips may also load up the wheel face, which will be detrimental to a good finish.

Recirculation can be prevented by allowing the particles either to settle out of the fluid or to float on top. For example, chemical fluids not containing wetting agents permit cast-iron chips to settle quickly while the graphite particles float on top so that they can be scraped off when they reach the coolant tank. If a wetting agent were present in this type of fluid, the chips would still settle to the bottom but the graphite particles would be wetted and would stay in suspension.

Although the ability to settle chips is desirable, the grinding fluid should not permit the chips to settle on the surface in excessive amounts. It should carry them into a settling tank. It may be necessary to filter the fluid to prevent stray particles from being recirculated as a result of their not having been trapped in the tank.

The detergent properties of a grinding fluid are affected by the wetting agents incorporated in it. A strongly detergent fluid will not only help keep a wheel face clean but will keep swarf from caking up in those portions of the system that are hard to reach. If heavy deposits have been permitted to accumulate in previous service, a fluid with considerable detergency can loosen them and cause the particles to start recirculating to the deteriment of the grinding operation. The obvious answer to this condition is to clean the system prior to grinding with the detergent fluid. Occasionally, an ingredient that contributes to the detergency of a chemical fluid may also soften the paint on the exterior of the machine.

Residues: The residue left on equipment as a result of the evaporation of a film or layer of a water-base fluid can be in the form of a liquid, paste, wax, or a hard solid film. Its nature will depend on the ingredients in the fluid. A fluid film with lubricating properties is the most desirable form of residue provided it does not harden or become sticky upon aging. Unless the residue can be readily redissolved, it can build up to interfere with the proper operation of the machine and can also give rise to high maintenance costs.

Particularly harmful is a hard crystalline deposit which cannot be dissolved in water but must be scraped away. This can occur when hard water evaporates, and also with nitrite solutions unless they are formulated to produce hygroscopic residues which can be easily wiped off or put back into solution. However, a hygroscopic material can itself cause trouble if mist arising from the grinding operation is permitted to get into an electric motor. The initially dry deposit may take up enough moisture during a humid day to create a short circuit.

Operator Considerations: Any undesirable effects that a fluid may have on the operator of the machine must also be taken into account. Grinding oils are often objected to on the basis of their inherent lack of cleanliness. Operator preference for a particular water-base fluid may be based on the ease with which the hands can be washed clean. In carbide grinding, for example, a number of otherwise suitable water-base fluids have been considered unsatisfactory because they permitted the fine carbide particles circulating in the fluid to adhere so

tightly to the skin that they were extremely difficult to remove at the end of the day.

Although some grinding fluids have given rise to skin trouble or dermatitis, most dermatitis problems can be traced to infections resulting from insufficient attention to machine and operator cleanliness and from the improper use of solvents for washing oily parts. Bacterial contamination of water-base fluids, which gives rise to offensive odors, is not believed to be a significant factor because the bacteria that survive in such fluids are generally not infectious in nature.

A more detailed discussion of the behavior of a grinding fluid away from grinding contact is available elsewhere[1,2,3].

Methods of Application

Flooding: The success of a grinding operation may depend not only on the type of fluid selected but also on the manner in which it is applied. By far the commonest way is to use a nozzle of sufficient dimensions to flood the work surface at a low pressure, *Fig.* 1. A flow of several gallons a minute per inch of wheel thickness is generally recommended. If the shape of the work interferes with reasonably uniform coverage of the surface near grinding contact, an additional nozzle may be required.

In some grinding applications, however, it is necessary not only to provide the proper direction of flow but also to use sufficient pressure to force the fluid into the vicinity of grinding contact where it can perform its intended function. This is particularly true in thread grinding, where the high wheel speed normally used crates a thin layer of air that adheres to the wheel and prevents the grinding oil from coming in contact with it when the oil is applied in large quantities but at ordinary pressures.

When the oil is applied at a pressure of at least 100 psi through small holes or slits in specially designed nozzles, it can break through the air film and reach the area of grinding contact. It is only there that it can improve the grinding action; otherwise, all that the oil can do it to cool the work after the heat has been generated. In one such case, high-pressure application of the oil from both above and below the work completely eliminated the softening of the thread surfaces that previously prevailed when the work was flooded with oil at a low pressure. It has also been found that the grinding ratio can be increased to a marked extent by applying the fluid at a high pressure instead of letting it flood the work[4]. This holds true for both oils and water-base fluids.

Mist: Another method of applying a grinding fluid is in the form of a mist, *Fig.* 2. When the geometry of the operation is such that it is particularly difficult to get the fluid coming out of an ordinary nozzle into the region of grinding contact, a finely dispersed mist may be able to penetrate into the area in question. Generally, however, a mist is used as a substitute for wet grinding when the machine is not equipped for this purpose, yet dry grinding does not provide sufficient cooling for the workpiece. Cooling is accomplished both by the evaporation of the mist, which eliminates the need for recirculating the fluid, and by the high-velocity air stream responsible for the formation of the mist.

The effectiveness of a mist in cooling the work by evaporation is greater for a water solution of a chemical fluid than for a soluble-oil emulsion, since the oil in the latter interferes with the evaporation process. For example, the grinding action may be completely unsatisfactory when a high-vanadium die steel is ground with a diamond wheel and a soluble-oil mist. It may be reasonably good, however, when a chemical-fluid mist is substituted. Even better results may be obtained by flooding the work surface[5].

When ordinary steels are ground with aluminum oxide wheels, the wheel wear is smaller for mist grinding than for conventional wet grinding but greater than for dry grinding[4]. In both instances, the grinding action is affected by the availability of the fluid in the vicinity of grinding contact.

Still another method applies the fluid through a belt wick, as is often done in carbide grinding[6]. Neither this method nor external mist application is effective in washing the chips away from the wheel, which may become loaded as a result.

Through the Wheel: An effective mist can also be created by applying the fluid through the wheel by means of specially designed flanges, instead of externally *Fig.* 3. In one method, only one or two drops a second are used, just enough to provide some cooling action at grinding contact. The fluid disappears by evaporation. No provision is needed for collecting and recirculating it.

In another method, a large quantity of fluid is fed continuously through the wheel, as much as would be pumped through an external nozzle in the same operation. A portion of the fluid can be applied externally to overcome the heavy mist associated with this method. It is necessary to keep the swarf from being recirculated with the fluid if the pores in the wheel are not to become clogged. In some plants, experience has indicated that both coarse and fine filtering are required to prevent such clogging. A chemical solution must be used because a soluble-oil emulsion is broken up by the fine filter. Other plants, however, operating under different conditions, have not found it necessary to take any special steps except perhaps to provide more time for the chips to settle. Not enough detailed information is available to explain why care-

[1]References are listed at the end of the article.

ful filtering is needed in some cases while settling of chips suffices in others.

The advantage of flooding the work through the wheel instead of externally is that it may substantially reduce the heat generated at grinding contact. As an example of what can be accomplished, cracking of the teeth of a large carburized spur gear during form grinding was eliminated by changing from external to internal flooding.

Principles of Selection

The suitability of a grinding fluid for a particular operation depends on numerous factors. Either the operation or the work material may dictate the choice of fluid. In thread grinding, an oil is called for regardless of the work material but the type of oil depends on the latter. With heat-treatable steels, an extremely wide variety of fluids can be used, excluding thread grinding and the like. There is likely to be a relationship between the type of operation and the type of fluid that is most satisfactory. For most other materials, the selection of the fluid depends on the material and not on the operation, with the exception of thread grinding.

In the majority of cases, selection of a fluid is primarily a matter of selecting technically competent sources of supply whose experience will be a satisfactory guide. But when the problem is more complex, an understanding of the functioning of grinding fluids will enable the user to judge better the relative worth of competitive products.

Since even the best possible fluid will not perform satisfactorily if it is used improperly, someone with technical training should have a voice in the selection of grinding fluids and in making sure that they are used properly rather than leaving this to individual foremen or operators. Some large users have found it necessary to have staff specialists, not only to get the most out of available products but also to help the suppliers develop improved products for specific purposes when better grinding performance is required.

When the machines are supplied with fluid from a central system instead of individually, it is necessary to select a fluid that will not give rise to trouble in any of the operations in the system. Some may call for an entirely different fluid than that for most of the operations. It is then best to supply those machines individually.

One advantage of a central system is that it obviously requires technical supervision and thus provides personnel capable of getting the most out of grinding fluids. Another advantage is that the temperature of the fluid can be readily controlled. This temperature has to be kept within a reasonably narrow range if fine-tolerance parts are to be produced economically on a production basis.

Oils: As has been pointed out previously, grinding oils are used when maintenance of a highly accurate wheel contour is essential. Thread grinding falls in this category, as well as form grinding of the serrated ends of jet-engine buckets. Oils are also used to minimize the generation of heat, primarily when the material is sensitive to it. Aircraft-engine gears are ground with oil for this reason but water-base fluids have been found to be satisfactory for most of the other gear-grinding applications.

Other operations are occasionally performed with grinding oils for the same reason. Oils are also used when grinding with crush-trued wheels since this method of forming the wheel is best accomplished with an oil.

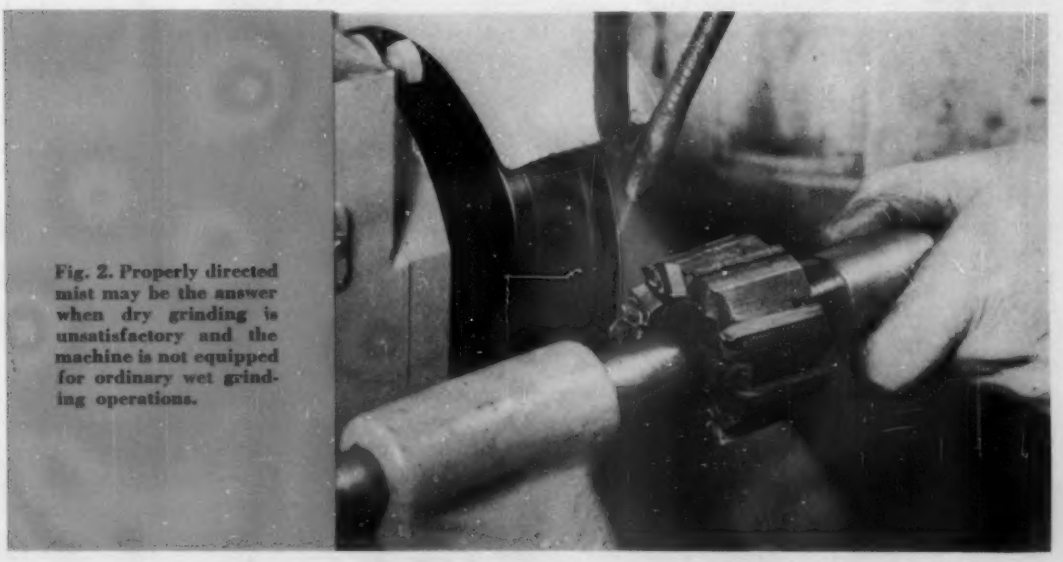

Fig. 2. Properly directed mist may be the answer when dry grinding is unsatisfactory and the machine is not equipped for ordinary wet grinding operations.

Two significant factors in the selection of a grinding oil for a particular operation are its activity under actual grinding conditions and its viscosity. The oil should not stain the work, and its viscosity should be high enough so that smoking and fogging do not occur. Since an active oil may make a grinding wheel act harder than when an inactive one is used, choosing the best oil for an operation may also involve changing the wheel specification. Opinions vary as to the kind of grinding oil that should be used in a given instance, partly because of a lack of fundamental grinding data and partly because there is a great deal of overlapping between various brands with respect to grinding performance. The best approach at present may be to run some carefully controlled tests with brands recommended by suppliers.

Water-Base Fluids: The same situation holds in connection with water-base fluids, which encompass a much wider variety of ingredients. An approach that some suppliers have found helpful in recommending grinding fluids is to consider them from the standpoint of their lubricity and detergency. Fluids that are high in lubrication value are low in detergency, and vice versa. High lubricity is usually associated with opaque, milky emulsions, and high detergency with transparent emulsions or solutions. The extreme conditions are represented by heavy-duty soluble oils and by chemical fluids free from wetting agents, respectively. Most fluids fall between these extremes in that they are formulated to possess a combination of lubricity and detergency.

High lubricity is considered desirable for rapid stock removal except when the grinding contact area is large, for minimizing wheel breakdown and loss of form in wet grinding, and for obtaining the best finish with a coarse wheel. The only successful water-base fluids for grinding austenitic stainless steel and aluminum are of the high-lubricity type. Since many such fluids are completely unsatisfactory in this connection, it follows that the specific nature of the ingredients in the fluid must be important and not just the high-lubricity feature itself.

Highly detergent fluids are likely to work best when it is important to keep the wheel clean. This occurs when fine-grit wheels are used, when light feeds are taken in finishing operations, and when the area of grinding contact is large, provided that a soft material like aluminum is not being ground. Such fluids are used in grinding cemented carbides and various types of cast iron because the fluids are successful in keeping the chips from recirculating.

There are other hard materials, like fully hardened tool steels and carburized steels, which are generally ground most effectively with a fluid possessing at least moderate lubricity, although a chemical solution may work better in broad-contact grinding. High-lubricity fluids are required for the austenitic stainless steels and for aluminum. They are not particularly effective for titanium alloys or for high-temperature alloys, although these materials fall in the hardness range in which austenitic stainless steels are found.

These examples show that the best type of water-base grinding fluid is not necessarily determined by the hardness of the work material. In many grinding operations, the complex requirements that have to be satisfied by the grinding fluid are best met by a fluid in the intermediate category, involving both lubricity and detergency.

Advantages of High Concentration: Considerable laboratory experience has indicated that whenever a water-base grinding fluid produces a specific benefit at grinding contact, the benefit increases with rising concentration of the compound in water. This is supported by the practical experience of a large roller-bearing manufacturer, who has found that a 7 to 10 percent concentration of a general-purpose soluble oil results in the most economical operation[7]. In order to obtain the best grinding performance, the wheel specifications had to be modified when the concentration was raised to this level.

The rich mixture not only affords excellent rust protection but also provides ample lubrication for the guides and slides on the machines and still has adequate cooling ability. Another manufacturer has found that rusting was eliminated and machine wear was reduced by changing to a 3 percent concentration of a soluble oil that is normally used at about one-third this concentration. It has also been observed that an increase in the concentration of a heavy-duty soluble oil is likely to improve the surface finish. If the fluid is of the chemical type, no significant improvement is to be expected.

The reason that low concentrations have been favored in the overwhelming majority of cases is that competition among suppliers has reinforced the user's natural tendency to minimize his cost per gallon in the tank. All too often, the grinding fluid has been thought of not as an aid in reducing grinding costs through operational improvements but simply as a necessary expense for coolant that should be kept as low as possible. However, it can be readily shown that the cost of a grinding fluid per part produced is so small compared to the total cost of grinding the part that an appreciably more expensive fluid is likely to be economically justified if the total cost of the grinding operation is reduced by only a relatively small percentage.

Expensive concentrates are frequently sold on the basis that they can be diluted more than cheaper products so that the cost per gallon of the final mix-

ture is less, or at least no greater. The ability to use safely a lower concentration of a high-priced brand sometimes leads the user to believe that he can save even more money by likewise reducing the concentration of the cheaper brand. Unfortunately, an excessively diluted compound will be incapable of preventing rust and an expensive machine may suffer considerable damage as a result of trying to save a negligible amount of money.

Practical Evaluation of Fluids: When grinding tests are performed to determine the relative value of various fluids, it is important to clean the machine thoroughly whenever one fluid is replaced by another. It should also be kept in mind that the same wheel may not be the best for all the fluids tested. A wheel that is too hard with one fluid may be just right for another. This does not mean that the second fluid is necessarily superior. It may simply be compensating for the hardness of the wheel.

For a really significant comparison of several grinding fluids, it may be necessary to evaluate them on the basis of power and grinding ratio. More than one grade of wheel may be required in order to permit the fluids to be compared by interpolation at some constant value of power or of grinding ratio.

Care should be taken to keep all other conditions unchanged while the fluids are being tested. When the ground parts will be subjected to high stresses in actual service, as in jet engines, other factors like surface finish and residual grinding stresses may also have to be considered in the evaluation of the fluids[8,9].

The results of such a study, which primarily involves the behavior of the fluids in the area of grinding contact, must of course be supplemented by appropriate investigations of the service properties that may be important.

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Powder Metallurgy Aids Camera Design

Less than 3/8 inch long, yet requiring exact alignment of two parallel holes, two tiny jammers are important components of the Models 850 and 900 Polaroid electric-eye cameras. They automatically lock the lens and shutter unit upright in precise picture-taking position when the camera is opened.

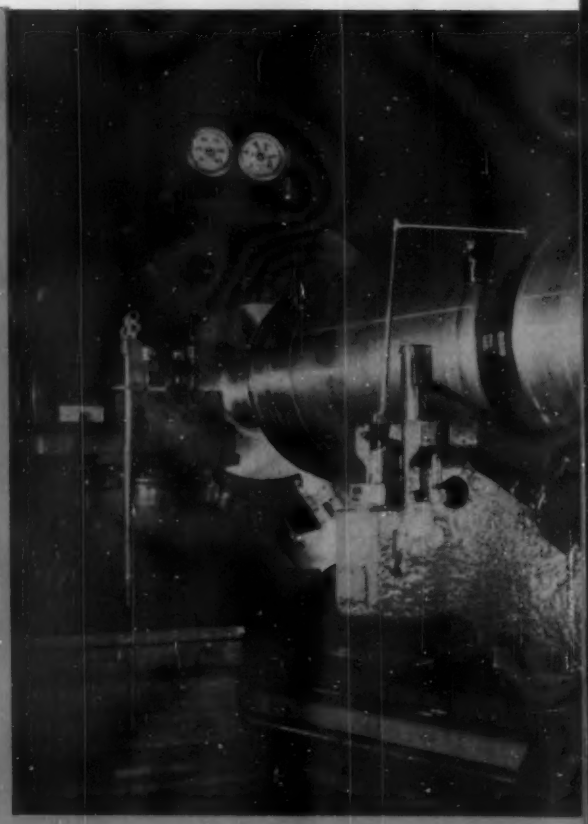
Because the jammers must have high strength and unusual corrosion resistance for trouble-free operation of the camera, stainless steel was specified. These design criteria gave rise to two major problems—machining stainless steel and making this small, yet complicated, part economically within allowable tolerances. The answer was found in powder metallurgy techniques developed by Dixon Sintaloy Inc. of Stamford, Conn.

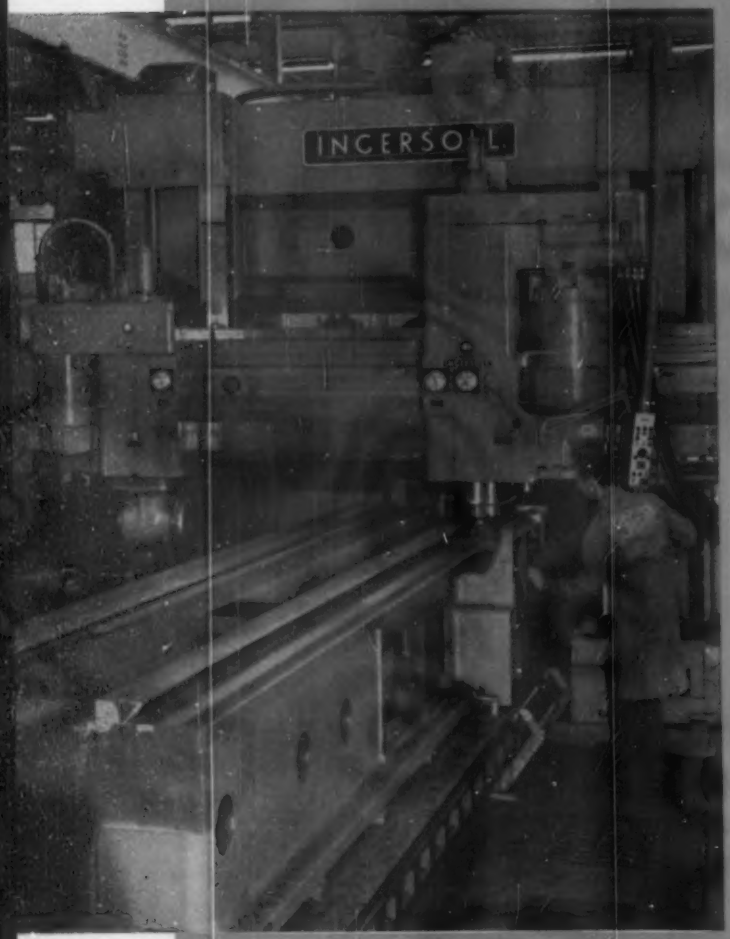
Many thousands of the jammers are currently being produced from AISI 316 stainless steel. After sintering close to specified print dimensions, a final coining brings each part well within the maximum allowable tolerances. For example, thickness of the jammer pad has a tolerance of ± 0.001 inch.

Powder metallurgy also makes it easy to keep the two bearing holes uniformly concentric within 0.002 inch TIR, as well as perpendicular to mating flats. Choosing powder metallurgy parts offers Polaroid yet another advantage—the jammers need no oiling during the life of the camera.

Sintering stainless steel is especially useful where intricate shapes are involved and when corrosion resistance is important. Although other metal powders, easier to fabricate, may be used in some instances, their corrosion resistance generally depends on a secondary operation such as sealing or electroplating. Using stainless steel powders eliminates this extra step and leads to a more economical and satisfactory component. Typical applications include sports equipment exposed to weathering; bearings and cams; and gear trains in water meters.

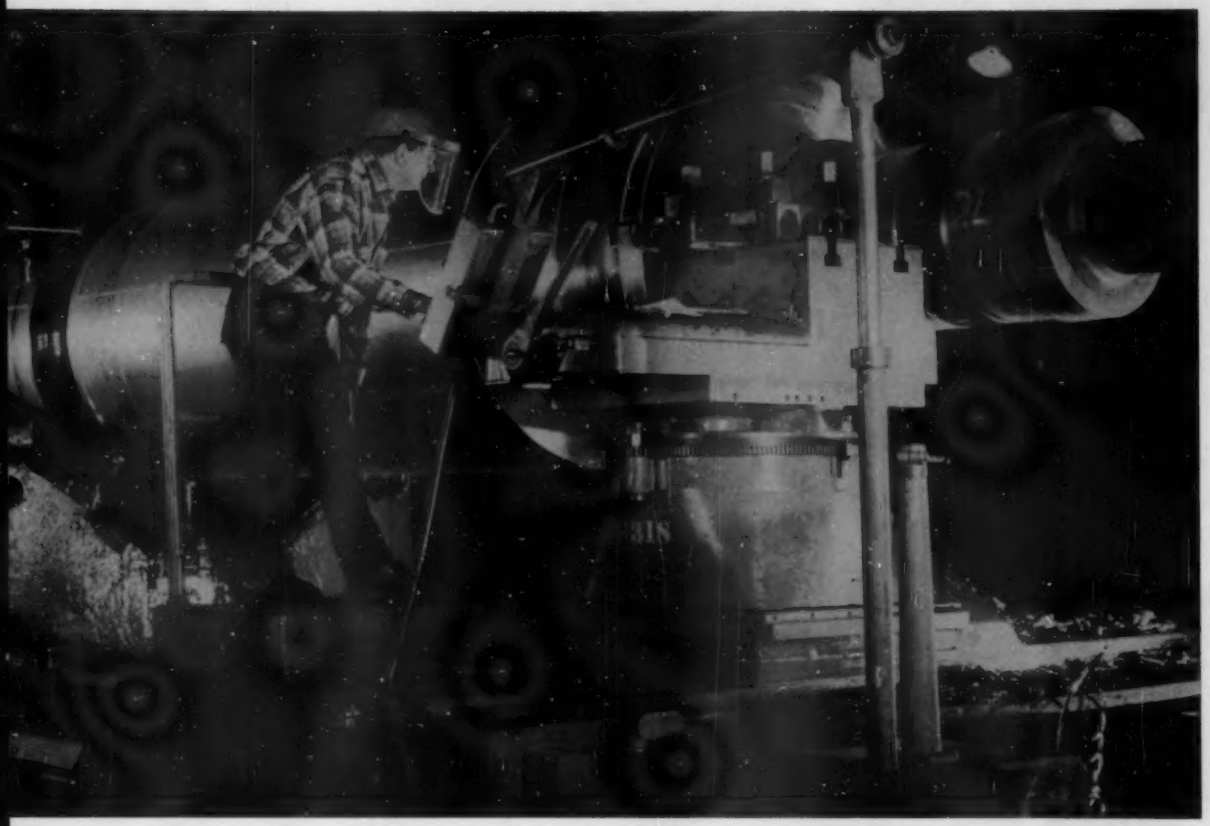
FORGED AND MACHINED from a 110-inch-diameter ingot of nickel-molybdenum-vanadium steel, this generator rotor, shown being machined at United States Steel's Homestead District Works, is nearly 39 feet long and has a maximum diameter of 59½ inches. The ingot was vacuum cast to insure uniform metallurgical characteristics. When installed in the completed generator, the rotor will spin at 3600 rpm, hence the importance of uniformity.



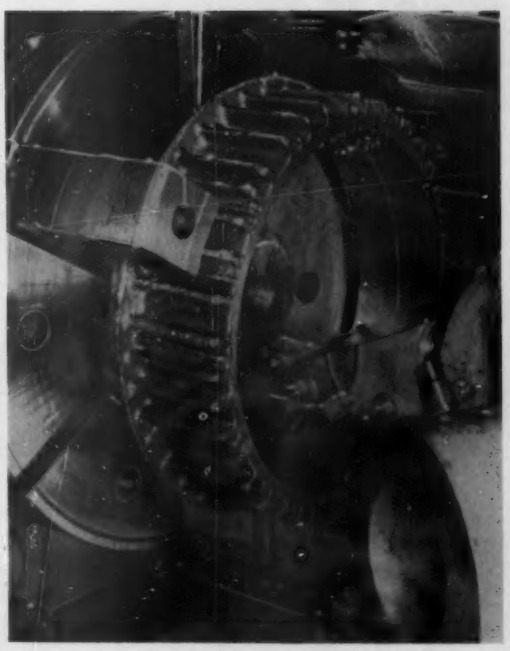


INSTALLATION of a 60-ft. planer type miller at DeVlieg Machine Co. has reduced handscraping on machine beds by about 50 percent, cut machining time 60 percent. The bed shown is of cast iron and is 24 feet long. Weight is 38,000 lb. Inserted-blade carbide cutters are used to take off from ⅜ to ½ inch of stock during roughing, 0.010 inch of stock in finishing. Cutting speeds range from 25 to 40 ipm. Because of the accuracy of the milling operation, which replaces a planing operation, handscraping is reduced by 70 hours. The Jigmil bed is flat within tenths after finishing and a basic accuracy of 0.0001 inch per foot for straightness and alignment of all surfaces is maintained in the finished bed.

TOOLS at work



BOTH MACHINING RATE and tool life have been doubled at an electrical apparatus manufacturing plant by changes and modifications of tooling for turning, facing and boring of cast steel armature drums. The operations are turning and facing a 4⅜ inch diameter hub and boring the 13½ inch inside diameter of the drum to a depth of 6 inches. The drums, of low-carbon cast steel, 150 Bhn, are machined on a 3A Warner & Swasey turret lathe at 0.009 inch feed and ¼-inch average depth of cut. When machining was done with modified standard brazed tip tools, there was considerable chatter from tool overhang and chip control was unsatisfactory with a ground-in chipbreaker. Chatter was minimized by shortening a standard Kendex boring bar to increase its rigidity and putting it in an overhead position. A change to Kennametal throw-away insert tooling with carbide chipbreaker plates provided effective chip control. The machining rate was upped from 300 fpm to 592 fpm. Feed and depth of cut were not changed. Ten to twelve pieces are bored per cutting edge, as compared to the former four or five pieces per grind.



USE OF A SPECIAL Wesson eight-blade precision boring head instead of a two-tool boring bar has reduced machining time — formerly 3.5 min. — to 20 sec on this cast-iron cylinder liner. Sleeve walls are 0.050 inch thick after the last boring operation, including a stock allowance of 0.004 to 0.006 inch for surface refinement. The operation is performed on the same dual-spindle machine previously used, which was modified by installing precision arbors with tapered mounting pilots for the boring heads. Air-actuated collet pots support the entire wall of the sleeve with minimum pressure during machining. Tool life averages 105,000 sleeves, with 3000 pieces per grind. Hourly production per spindle is 136 sleeves, twelve times the former production rate. The operation is at Aluminum Industries.

TOOLS at work

checking the STRESS PATTERNS of rotating gears

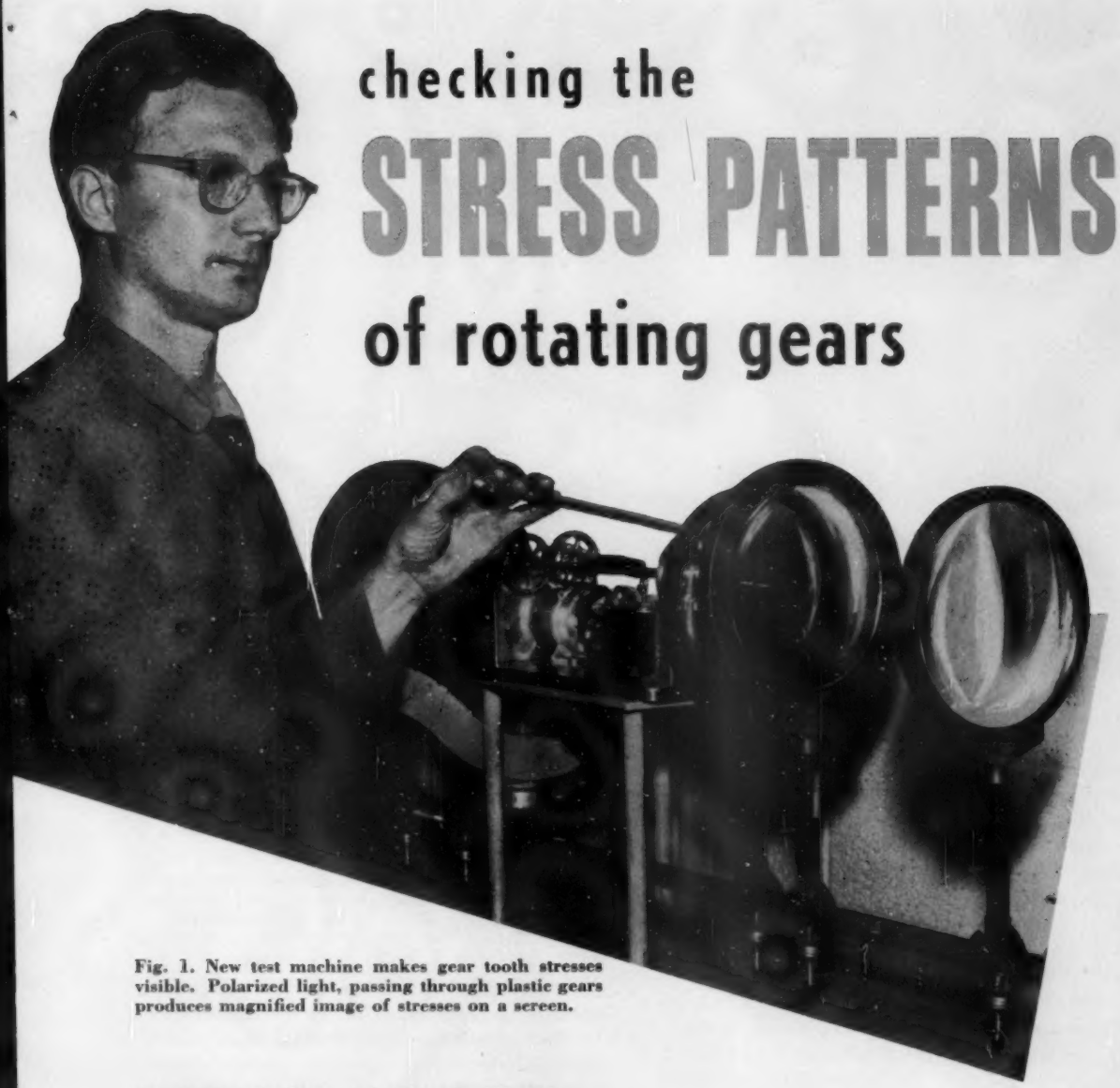


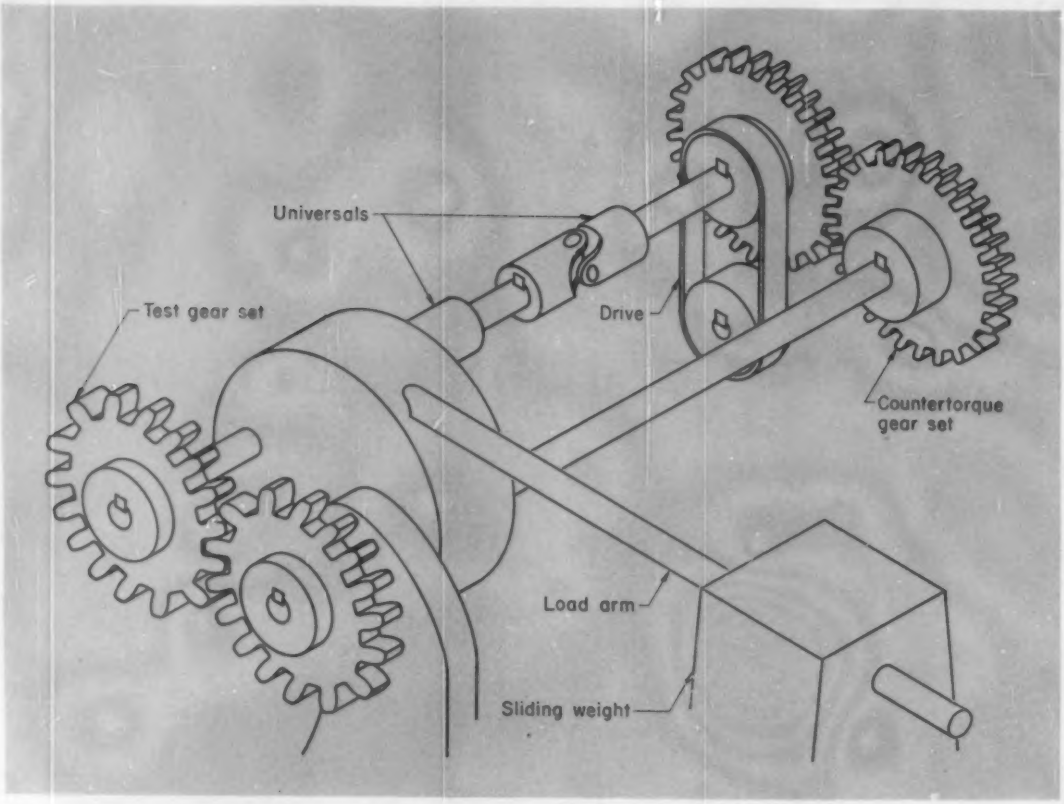
Fig. 1. New test machine makes gear tooth stresses visible. Polarized light, passing through plastic gears produces magnified image of stresses on a screen.

By James Irvine and **Joseph Silvagi**
Holley Carburetor Co., Warren, Mich.
Camdale Precision Inc., Roseville, Mich.

Stresses in rotating plastic gears are magnified and projected on a screen with a testing device developed at Wayne State University. Direct observation of stresses in gears under load gives insight into the reasons for gear failure and may lead to improved gear design.

AN UNDERSTANDING of gear tooth stresses is fundamental to sound gear design. In a metal gear, these stresses are invisible, and stresses have traditionally been studied by running the gears under increasingly heavy loads until they break.

Some understanding of stresses has been gained by studying gears made of photoelastic materials. These materials, usually plastics, are transparent and their optical properties change when they are stressed. When polarized light is passed through a gear of photoelastic material when it is under load, patterns of dark lines or fringes appear. The greater the density of a line, the higher the stress



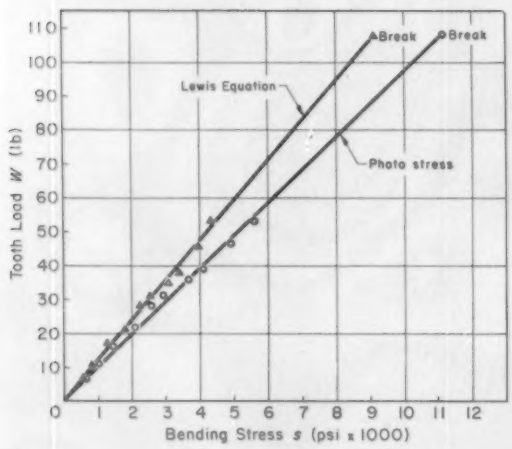


Fig. 2. (above) Schematic diagram of gear-test machine. Test gears are of plastic, machined to close tolerances.

Fig. 3. (left) Tooth-load and bending stress have a straight-line relationship. There is some deviation from the results predicted by the Lewis Equation.

in the vicinity of that line.

Most of the more recent and accurate equations on which gear tooth stress calculations are based were developed empirically from studies made on gears of photoelastic materials. These empirical equations have been partially verified by tests on actual steel gears.

Until recently, all photoelastic studies were made on gears that were loaded statically. Static loading, however, leaves much to be desired, since gears are dynamically loaded in service. With static loading, it is impossible to study dynamic effects—in particular the dynamic addition to the transmitted load, the effect of transference of the load from tooth to tooth and the velocity effect on surface stresses. Since only single teeth are loaded in the usual static testing techniques, the load-sharing effects of pairs of teeth in contact cannot be observed. Further, since the load is applied by a rod, not by an actual gear, the study of the effect of surface curvature on surface stresses is prevented, as is the study of the true spread of those stresses as they combine with bending or compressive stresses.

The static loading studies on which present-day stress equations are based were unrealistic in several other ways. The gears used were not actual machine-generated gears, but were subject to the inaccuracies of hand layout and incremental milling or filing. Usually, the ratio of tooth size to material thickness was not typical of metal gears.

These limitations have been overcome in a new gear testing machine developed by the authors at

Wayne State University. The machine, *Figs.* 1 and 2, is basically a combination of one of the four-square methods of gear testing, photoelastic test gears and a polariscope—an instrument that plane-polarizes ordinary light in any desired azimuth.

In the machine, a fractional horsepower electric motor with 15 lb-in capacity is used to apply a torque to a pair of test gears, varying from zero load to tooth-breaking load. The light, which may be white, producing colored fringes, or monochromatic, which gives better discrimination, is directed through a Polaroid sheet at one end of the machine, then passes through the open areas in the spoked driving gears, through the point where the test gears engage, through another Polaroid sheet and finally through a condensing lens. The image is magnified or projected on a screen by an additional lens. The condenser lens combines the light and no effect of the gear spokes is observed on the image of the test gear teeth, even though they interrupt the light beam as the gears rotate.

The gears used in initial tests were of Columbia resin. This material was sandwiched between steel plates so that accurate 15-tooth, 6 diametral pitch gears could be generated on a hobbing machine. Spacing and involute profile errors were held within 0.001 inch. Slow, light cuts produced gear teeth without edge chips and left no residual machining stresses. The hob generated root fillets of approximately 0.08-inch radius. The test gears were loaded until tooth failure occurred.

During operation, the moving images were magnified from a tooth height of $\frac{3}{8}$ inch to about six inches by projection onto a screen. Formation of fringes was observed on the tension or loaded side of the tooth profile at the root fillet, which was the point of greatest stress. With a 1-lb load on the arm, which amounted to 3.6 lb on the tooth, a single fringe was produced. Additional loading produced more fringes, indicative of both tensile and compressive stresses. The types of stress encountered are shown in *Fig.* 4. There is a sudden surge of stress at the impact of tooth engagement and another surge, somewhat smaller, when the tooth becomes disengaged.

Loading of the teeth was accomplished rapidly, to avoid the effect of fatigue failure. A break occurred in the root fillet at a maximum tooth load of 108 lb. Twenty-two fringes existed at the moment of failure.

Due to the absence of buckling, which occurs when thin materials are used for gear models, and due also to the accuracy of the hobbed teeth, the tooth load values obtained had little deviation from a straight line, *Fig.* 3. These tooth load values were used in the Lewis tooth strength equation to obtain stresses and these were plotted on the same graph for comparison. Photoelastic methods indicate that

Fig. 4. Image of gear tooth stresses as made visible by the gear test machine. Top gear is the driver. Dark lines indicate regions of maximum stress. This photograph was taken just after the engagement of the second tooth—a time of high stress.

108-lb tooth loading causes failure at 11,000-psi stress. The Lewis Equation predicts that failure will occur at a stress of 9078 psi with the same load.

A calibration specimen was given a tensile test to determine the stress value per fringe. The number of fringes observed in the loaded gear teeth multiplied by the stress value per fringe gives the stress in the teeth. Tests were made with the teeth at rest and in motion. As might be expected, the teeth broke at smaller loads for the rotating gears.

A further test was performed to determine beam strength of the specimen gear teeth. Applying a load near the top of a tooth in the region of highest point of single tooth contact, a force of 98 lb was required to cause tooth breakage. This was an independent test in which a spring scale was used to apply the direct load to the tooth.

Solving for bending stress:

$$s = \frac{WP}{fY} = \frac{98\ (6)}{0.247\ (0.289)} = 8170 \text{ psi}$$

where s = bending stress, psi; W = tangential tooth load, lb; P = diametral pitch; f = face width of gear, inch; and Y = a tooth geometry factor. The answer, 8170 psi, agrees well with the results obtained with the test machine.

Beyond the tests described, little work has as yet been done with the new machine. Further use of the machine, which will be provided with size adjustment, should make it possible to develop new and all-inclusive gear tooth stress equations.

The authors gratefully acknowledge the encouragement furnished by Professors Vogel and Lebow, Wayne State University.

how to schedule tool programs with magnets

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Scheduling with magnets. Status of twenty jobs is readily visible in position of magnets.

Because many unknown factors disrupt the progress of tool fabrication, conventional scheduling techniques in toolrooms are generally ineffective. In this article the author explains a new method of scheduling tooling programs.

SCHEDULING of fabrication time for tooling is often complicated by delays in steel deliveries, machine breakdowns and tool warpage in heat treat. In addition, the lack of fixed precedents when estimates are made generally results in deviations from estimated time requirements. Because of these variables and unknowns, conventional scheduling methods are ineffective in controlling the flow of work in toolmaking departments. To overcome these difficulties one company, Holloware Division of Oneida, Ltd., has devised a flexible scheduling board that can be revised whenever the necessity arises.

The company's first step in creating a new scheduling procedure was to itemize the requirements which could be realized only in an ideal scheduling layout. These are:

1. Flexibility. This is necessary to compensate for variables and unknowns
2. Comprehensiveness. The entire tooling program should be viewed as a unit without reference to subschedules
3. Job status. Expended time, future workloads and completion dates should be visible at all times.

Various peg-board setups were experimented with but none of them was able to provide the desired flexibility and comprehensiveness. It was then decided to layout the schedule on a piece of sheet steel and use magnets to denote periods of time.

The steel sheet selected for this job was painted white and gridded with horizontal and vertical lines an inch apart. In use, each of the vertical columns is assigned to one tool. The horizontal lines running through these columns each indicate a 40-hour week. No provision is made for overtime, since this factor is regarded as a cushion.

Magnets used on the scheduling board have lengths of ¼, ⅜, ½ and ¾ inch which represent time elements of 10, 15, 20 and 30 hours respectively. Color coding of the magnets is necessary to permit identification of the various activities in which time is expended on any given job. For example, tool design is denoted by pink, general machining by yellow and tool tryout by gray. If on a certain job, tool design time is estimated at 20 hours, a pink magnet, one-half inch long will be used to denote this activity. Other activities readily identified by color are pattern making, material delivery, kellering, heat treat, die sinking, die fitting and mold fitting.

Identification of the jobs in progress is made on a strip of paper across the top of the board. A similar strip bearing dates of current work weeks is mounted vertically at the left side of the board. Scheduling is accomplished by placing magnets of appropriate length and color in the proper column according to desired dates. Different activities accomplished simultaneously can be scheduled by placing magnets side-by-side in the same square. As work proceeds, magnets are removed accordingly.

Many benefits result from scheduling by this method. Perhaps its most important benefit—in addition to desired flexibility—is the ability it provides to foresee and eliminate possible overloads in any area of shop activity.

REFERENCE SHEET

TURNING
Aluminum Alloys

WROUGHT ALUMINUM ALLOYS can be classified into two broad groups: those that can be heat treated and those that cannot. The alloys that cannot be heat-treated consist of single-phase structures that are readily machined. However, the finishes produced on these alloys are generally poor because of the tool build-up that occurs during machining.

Wrought alloys that can be heat treated have improved mechanical properties because of the presence of a secondary phase in the aluminum matrix. These alloys can be easily machined to close tolerances and the finishes they produce are excellent. Because of their higher strength, the maximum cutting speeds permissible on these materials are slightly less than for other aluminum alloys.

The casting alloys containing copper or magnesium have excellent machinability and can be turned with heavy feeds. Both types can be used when good finishes are required.

The aluminum-silicon alloys have better casting characteristics than the copper-magnesium groups but they have poorer machinability and must be turned at lower speeds. If relatively high quantities of silicon are present in either type, tool wear is poor because of dendritic segregation in the casting. Other factors adversely affecting machinability and tool life are uncontrolled porosity, excessively large grain size and incorrect amounts of alloy.

Aluminum alloys are easily machined with carbide cutting tools. In normal turning, light feeds and high speeds are used, and on finishing cuts the lathe is generally run at full speed. Because these alloys have a low modulus of elasticity, workpiece support is mandatory during turning. This is especially true on light sections where tool pressure tends to cause workpiece deflection.

When aluminum-copper and aluminum-magnesium alloys are machined, chip breakers should be used. Because tool build-up is an ever-present source of trouble in machining these alloys, the breaker width should be comparatively wide. Widths between 0.093 and 0.140 inch provide the best results.

Cutting fluids are necessary in turning aluminum alloys if close tolerances and high-quality finishes are required. In most cases soluble oil coolant applied directly to the work provides satisfactory results. On light finishing cuts kerosene-base oils are most effective in minimizing tool build-up and thereby improving surface finish.

From "Speeds and Feeds for Better Turning Results", published by The Monarch Machine Tool Co., Sidney, Ohio.

REFERENCE SHEET

Table 1—Speeds and Feeds for Turning Aluminum

Type of Alloy	Roughing Speed (fpm)	Roughing Feed (ipr)	Finishing Speed (fpm)	Finishing Feed (ipr)
Wrought:				
2011	2000-2600	0.006-0.015	2000-3000	0.003-0.008
3003, 3004, 5052, 5056	1600-2200	0.004-0.011	1800-2600	0.003-0.008
4032	800-1200	0.006-0.013	1000-1400	0.002-0.006
2014, 2017, 2024, 6051	1200-1800	0.009-0.018	1600-2400	0.003-0.008
6061, 6063, 7075	1200-1800	0.009-0.018	1600-2400	0.003-0.008
Cast:				
108, 112, 113, 122, 195, 212	1300-2000	0.009-0.018	1600-2600	0.003-0.008
218, 220	2000-2600	0.009-0.020	4000 Max.	0.004-0.010
132, 333, 355, 356, 319	800-1500	0.006-0.013	900-1700	0.002-0.006

Table 2—Machinability Ratings of Wrought Aluminum Alloys

Alloy Type	Si	Cu	Mn	Mg	Other	Hardness (Bhn)	Machinability*
Work Hardenable							
3003-H18	—		1.2	—	———	55	180
3004-H38	—		1.2	1.0	———	77	180
5052-H38	—		—	2.5	0.25-Cr	77	190
5056-H38	—		0.1	5.2	0.10-Cr	100	190
Free Machining							
2011-T3	—	5.5		—	0.5-Pb	95	200
Heat-Treatable							
2014-T6	0.8	4.5	0.8	0.4	———	135	140
2017-T4	—	4.0	0.5	0.5	———	105	140
2024-T4	—	4.5	0.6	1.5	———	120	150
6051-T6	1.0	—	—	0.6	0.25-Cr	100	140
6061-T6	0.6	0.25	—	1.0	0.25-Cr	95	190
6063-T6	0.4	—	—	0.7	———	73	190
7075-T6	—	1.6	—	2.5	5.6-Zn	150	120
4032-T6	12.2	0.9	—	1.1	———	120	110

*Machinability index for each alloy is based upon B-1112=100 percent.

Table 3—Machinability Ratings of Cast Aluminum Alloys

Alloy Type	Si	Cu	Ni	Mg	Zn	Hardness (Bhn)	Machinability
108	3.0	4.0	—	—	—	55	140
112	—	7.0	—	—	1.7	70	180
B-113	2.0	7.0	—	—	1.7	70	180
122-T	—	10.0	—	0.3	—	115	140
195-T	0.8	4.5	—	—	—	75	190
212	1.2	8.0	—	—	—	65	160
A-214	—	—	—	3.8	1.8	50	200
220-T	—	—	—	10.0	—	85	230
218-T	—	—	—	8.0	—	70	240
A-132-T16	12.0	—	2.5	1.0	—	125	110
D-132-T16	9.0	3.5	0.8	0.8	—	105	130
333-T16	9.0	4.0	—	—	—	100	130
355-T16	5.0	1.3	—	0.6	—	90	160
	7.0	—	—	0.3	—	90	140
319-T16	6.3	3.5	—	—	—	95	160
750-T16	—	1.0	1.0	—	—	45	180
A-612-T16	—	0.5	—	0.70	6.5	70	—

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Services INCREASE . . . Dues REVISED

NEARLY TWO YEARS AGO the Long Range Planning Committee made a detailed review of the dues structure, giving particular emphasis to the services provided for members. The study convinced the committee that "the individual member should be expected to support a larger percentage of the organizational operation of the Society." Consequently, in the fall of 1960 at the Semiannual Meeting in Los Angeles the long range planners reported to the ASTME Board of Directors:

> "A dues increase appears to be in order for our membership. Such an increase would have a beneficial effect upon the total membership of the Society."

Acting on the LRP recommendation, the board appointed a subcommittee to further investigate the matter and report their findings at the 1961 Annual Meeting. Headed by Wayne Ewing, 1959-60 national president, the group consisted of directors Charles M. Smillie, Dean F. Saurenman and H. Dale Long, ex officio.

After five months of study, the subcommittee brought before the board their recommendations for putting the income from members' dues more into line with the Society's member activity expenditures. Their report wholeheartedly concurred with the LRP Committee's conclusion that a dues increase is "very much in order" if ASTME is to continue its dynamic growth in service to the individual member.

The subcommittee reported that a study of dues in similar societies showed the present ASTME Senior Member dues of $10 per year to be comparatively low. The average regular member dues in other engineering societies, they said, are over $16 a year.

Basic Thinking Behind Increase

But Society leaders agreed that the dues of like organizations were a minor consideration in their deliberation. Basically, the thinking behind the dues increase revolved around two points: increased service to the member and sound financial policy.

A glance at the past, said the directors, shows a raise in dues to be just plain good economic sense —and long overdue. Back in 1945, when Senior and Associate Member dues first became $10, the young Society was spending $10.54 a year on each of its 18,000 members. Since that time added member services have each year increased the Society's expenses as well as the member's return on his dues investment. Today, the Society spends over $50 a year on each of its 41,000 members.

Besides the rising cost of steadily increasing member services, the Society—like everyone else—is affected by the rising cost of living, pointed out the board. During the last 16 years, while the Society's expenses rose about $40 per member, the value of the dollar dropped 50 percent. Thus, the $10 dues, with only half as much buying power, now bring the member a return nearly five times greater than in 1945.

Increase Weighed in Terms of Service

Figures and dollar signs, however, never tell the whole story. Cognizant of this, the Society's leaders in the final analysis weighed the dues increase in terms of the only reason ASTME exists—service to the membership.

The average member, they said, joins the Society for self-improvement in the realm of technical know-how. The Society in turn, fulfills its purpose and meets the member's demands by supplying him with seemingly endless opportunities to achieve his goal. At the chapter level are monthly technical meetings, educational tours of local industry and valuable contact with other tool and manufacturing engineers. At the national level are technical seminars conducted by top men in the field; educational activities such as On-Campus Conferences and refresher courses; authoritative reference books in

the field of tool and manufacturing engineering, made available to the member at discount price; complete reports of ASTME-sponsored research performed by trained scientists in leading universities; annual engineering conferences and tool expositions which spotlight the newest manufacturing developments and equipment; and the Society's monthly magazine, THE TOOL AND MANUFACTURING ENGINEER, which keeps the member up to the minute on manufacturing know-how and each year gives him a comprehensive listing of national and local sources of engineering information.

Added to these direct member services are the varied Society activities that benefit the member indirectly by serving the tool and manufacturing engineering field, industry, education, government and the general public. ASTME programs in research, standards, professional development and education are all in this category.

The fact that the majority of the present member services have been initiated in the last 16 years, explained the Society's leaders, evidences not only the dynamic development of the Society, but the necessity of the dues increase. Each year since 1945 the $10 dues have been stretched to help support new and needed services such as the research and professional development programs, the national Creative Manufacturing Seminars, the Manufacturing Engineering Information Services issue of THE TOOL AND MANUFACTURING ENGINEER and the publication of *Bibliography of Metal Cutting* as well as two editions of *The Tool Engineers Handbook*.

Delegates Support Increase

Discussing the dues increase at the Annual Meeting in Detroit last year, the House of Delegates, who officially voice the views of the ASTME chapters, voted to endorse any board action involving such an increase. Inasmuch as the Board of Directors is responsible for the dues, the delegates indicated their support in the form of the following motion:

> "We, as a representative body of our membership, do signify to our national directors our willingness to accept an increase in dues if and when it is deemed absolutely necessary for the good operation of the Society."

This year at the Annual Meeting in New York, the Board of Directors agreed that an increase in dues is necessary because of the Society's rapidly expanding member services and the resultant rise in operational costs. Thus, in light of the delegates' motion, the directors approved a $5 increase in the annual dues of Senior and Associate members. The same increase will apply to the new Regular Member category, which is discussed in an article on Page 77.

Otherwise, the dues structure of the Society will remain unchanged. The board voted to keep Affiliate Member dues at $50 a year and Student Member dues at $3 a year, with no initiation or reinstatement fee required for either group. For Senior, Regular and Associate members, the initiation fee remains at $5 and the reinstatement fee at $2.50.

The percentage of annual member dues returned to the chapter by National will also stand pat, voted the directors. As in the past, the home chapter will receive 25 percent of Senior and Associate Member dues, 85 percent of Affiliate Member dues and 33 percent of Student Member dues. The chapter dues allocation for the new Regular Member grade will be 25 percent.

Because the Constitution stipulates that changes in the Bylaws may be made by the affirmative vote of 11 or more directors, the board action in New York officially amends the Bylaws and raises the dues of Senior, Regular and Associate members from $10 to $15 a year.

This dues increase—the first in 16 years—will go into effect at the same time as the membership grade changes recommended by the Long Range Planning Committee. By vote of the board, both programs will be initiated at the beginning of the fiscal year, Oct. 1, 1961.

Increase Necessary For Future Service

The years that lie ahead will make even more demands on ASTME than those just past. As the tool and manufacturing engineer becomes an increasingly important figure in this age of space and automation, his needs are rapidly growing and changing. His Society then must grow and change too, accelerating and expanding its services to meet his needs.

By 1975, estimated the Society's LRP Committee, ASTME will have 70,000 members throughout the nation and the world. To prepare to serve these members to the fullest extent, the committee outlined a program of services and activities that should be undertaken in the near future. A new ASTME Headquarters facility, a stepped-up program for publishing textbooks and reference books in the field of tool and manufacturing engineering, a research and educational grants program, correspondence courses in the field of manufacturing technology and a central library service of tool and manufacturing engineering literature are but a few of the long range planners' recommendations.

The dues increase, concluded the directors, will play an important part in providing the competent Society service necessary now and in the future. In the over-all picture, they added, it will play an equally important part in guiding ASTME toward its objective—"the establishment of the Society as the leading engineering and technical service organization in the field of manufacturing."

NEW LOOK

in Membership Lineup

THE NEW FISCAL YEAR, starting Oct. 1, will bring several constitutional changes to substantially raise the professional level of the Society by upgrading membership qualifications.

Recommended by the Long Range Planning Committee, endorsed by the Board of Directors at the 1960 Semiannual Meeting and approved by the membership in a Society-wide referendum, the changes will establish a new membership lineup that has obviously gained the support of most everyone concerned.

Basically, the new lineup will raise the qualifications for Senior Membership, add a Regular Member category, eliminate the current Junior Member classification and continue the requirements for all other levels of membership—Associate, Affiliate, Life, Student and Honorary—as they presently stand. In effect, Regular Member replaces Junior Member and raises the qualifications for that grade.

The ultimate goal of upgrading the over-all membership must be a transitional development, stressed the LRP Committee. In other words, the constitutional changes which upgrade future membership qualifications, will in no way downgrade the rights and standing of any present member of the Society. The new membership requirements will apply only to those who join the Society after Oct. 1, 1961.

Recognizing that the present Senior grade comprises over 75 percent of the membership and realizing that many of these Senior members have contributed greatly to the Society during its formative years, the long range planners carefully and pointedly included a "grandfather" clause in the new requirements for Senior Membership:

> "Any Society member classified as a Senior on the date of passage of this amendment to the Constitution shall continue to hold the grade of Senior Member in the Society as long as he shall remain in good standing."

Thus, any member who is classified as a Senior on Oct. 1 will remain in that grade as long as he keeps up his membership in the Society. Any member who drops his membership and is later reinstated will be classified in the grade for which he qualifies at the time of reinstatement.

Another provision in the forthcoming membership changes advances the status of present Junior Members. All members in that category will automatically move up to the grade of Regular Member and the Junior classification will be abolished.

New Requirements Spelled Out

According to the new upgraded qualifications for Senior Membership, applicants who have reached the age of 30 may qualify for Senior standing in the Society if they have a degree in science or engineering from a recognized school and/or professional registration, plus five years experience in one or more of the following categories:

1. A tool or manufacturing engineer of recognized ability to plan the order of operations, layout or supervise the design and manufacture of tools and equipment.
2. An executive having knowledge of tool and manufacturing engineering and having responsibility for manufacturing any industrial equipment.
3. A tool, die or machine designer with experience in the design of tools, dies, gages, machines and accessories for any material.

If the applicant has neither the required degree nor professional registration, but is 30 or more years of age, he may still qualify for Senior Membership upon completion of ten years experience in one or more of the categories listed above. Academic training in a recognized technical or engineering school will count as experience on a year-for-year basis.

Future applicants for Regular Membership in the Society must be at least 20 years of age and possess any one of the following qualifications:

1. A tool and manufacturing engineer who is a person of recognized ability to plan the order of operations, layout or supervise the design and manufacture of tools and equipment.
2. An executive having knowledge of tool or manufacturing engineering and having responsibility for manufacturing any industrial equipment.
3. A tool, die or machine designer having five years experience, which includes tools, dies, gages, machines and accessories for any material.

Again, academic training in a recognized technical or engineering school will be accepted as experience on a year-for-year basis.

Both Senior and Regular members will carry voting rights in the new membership lineup.

Keeping Abreast of Industry . . . Society Offers 11 Seminars

KEEPING ABREAST of the rapid advances in manufacturing is a real problem for many tool and manufacturing engineers. With this in mind, ASTME is planning 11 National Creative Manufacturing Seminars for 1961-62. These seminars, covering everything from short-run tooling to high energy rate forming, will stress the case study approach to show specific applications of new developments in manufacturing.

Conducted by leading experts in the field of manufacturing, the seminars are designed to solve the engineer's manufacturing problems, increase his manufacturing know-how, bring him up to date on technological progress and improve his company's production efficiency.

This season's seminar schedule, starting in Detroit and closing in Cleveland, covers miles of territory both geographically and technically:

High Energy Rate Forming
Sept. 27-28, Statler Hilton Hotel, Detroit
Manufacturing with Space-Age Materials
Oct. 10-11, Sheraton Hotel, Philadelphia
Prototype and Short-Run Tooling Methods
Nov. 8-9, Belmont Plaza Hotel, New York
Electric Machining and Forming
(Electro Metal Removal)
Dec. 6-7, Statler Hilton Hotel, Hartford, Conn.
Prototype and Short-Run Tooling Methods
Jan. 23-24, Barringer Hotel, Charlotte, N. C.
Die Design and Press Tooling
Feb. 7-8, Statler Hilton Hotel, Hartford, Conn.
Automatic Production—Numerical Control
Feb. 27-28, Statler Hilton Hotel, Cleveland
Prototype and Short-Run Tooling Methods
Mar. 7-8, Statler Hilton Hotel, Dallas, Tex.
Carbide and Ceramic Tooling
Mar. 28-29, Conrad Hilton Hotel, Chicago
High Energy Rate Forming
April 11-12, Brown Palace Hotel, Denver, Colo.
Process Planning and Manufacturing Reliability
May 7-8, Sheraton Cleveland Hotel, Cleveland

The three sessions on "Prototype and Short-Run Tooling Methods" are not repeats but completely different programs, oriented to the types of industry in the area where the seminar is held.

The opening session—"High Energy Rate Forming" in Detroit—covers a recent development that is fast becoming a well-established tool of industry. In general, the program will concentrate on the metallurgical characteristics of high energy rate formed materials and the development of HERF (high energy rate forming) process parameters. The seminar will also explore the automation of HERF systems.

During the two-day session in Detroit, Aero-Space Div. of Boeing Airplane Co. will present a study of one of the newest applications in the HERF field—the use of gas mixtures for explosive forming. Other companies presenting case studies at the seminar include Rocketdyne Div., North American Aviation; Ryan Aerospace Div., Ryan Aeronautical Co.; and Westinghouse Electric Corp.

ASTME seminars are sponsored by the newly created National Engineering Conference Committee in cooperation with the Society chapter in the city where the program is held.

Members in the News

Pen in hand, Sherwood J. Basch, who has been with Morton Mfg. Co. since 1940, is ready to sign his name under a new title. Basch, who is a member of Muskegon chapter, was recently appointed vice president of engineering at Morton.

ORLAND W. BOSTON of Ann Arbor chapter was presented with the ASME certificate of appreciation at that society's Design Engineering Conference held recently in Detroit. Boston, professor emeritus of mechanical and production engineering at the University of Michigan, received the award for his work on an ASA committee devoted to developing standards in the field of small tools and machine tool elements.

JOHN E. ALDEBORGH, Mid-Hudson chapter member, has been elected executive vice president of Standard Gage Co., Inc. following 13 years of experience in every phase of the company's manufacturing, engineering and research departments. Most recently, he was vice president in charge of sales.

Sprague and Henwood, Inc., has announced the promotion of two Keystone chapter members. LEROY W. JANSON, past chairman of Keystone, was appointed vice president in charge of manufacturing and engineering; STANFORD JONES will assume the duties of chief engineer.

DANIEL J. WILLIAMS, JR., has been promoted to manager of Producto Machine Co.'s Cleveland plant. A Cleveland chapter member, Williams was vice president of the Connecticut Tool and Engineering Co. before joining Producto.

Formerly factory manager for the Houston-Fearless Corp's Los Angeles plant, JOSEPH G. ROSALES, San Fernando chapter, has been named vice president for production at American Orbitronics Corp. Rosales' wide experience in the metals field began in 1920 with the Mohegan Co. and he has since been with Northrop Aircraft, Inc., Sperry Gyroscope, American Can Co., and AiResearch Mfg. Co.

DAVE COLE and FLOYD WRASSE, past chairmen of Mansfield chapter, are part of a team organizing the Mansfield Technical Institute. The two-year school will prepare students to become engineering aides or technicians in industry.

WALTER B. WIGTON, member of Cincinnati chapter, who last year served on the National Technical Publications Committee, has been named chairman of the electrical technology department at the Ohio College of Applied Science, Cincinnati. His most recent positions have been chief engineer of the Cincinnati Gilbert Machine Tool Co. and manager of the Davis Div. of Giddings & Lewis.

New chief engineer of Hoover Electronics, Baltimore, is RALPH B. NOTTINGHAM, previously quality control manager at North Electric Co., Galion, Ohio. He is a member of Mansfield Chapter 135.

LEROY B. MONOSMITH, past chairman of Rockford chapter, is on a two-year assignment in Paris as manager of a new Sundstrand Machine Tool plant. Replacing Monosmith, who was in charge of the perishable-tool engineering department at Sundstrand's Belvidere plant, is FRED R. SWANSON, also a Rockford chapter member.

Missiles and "Trends" Take Spotlight

DENVER, Colo.—Denver University set the stage for Chapter 77's recent conference on "Trends in Manufacturing." Subjects ranged from metal fracture to the history of measuring standards, procedure in design problems and epoxy resins. In the closing speech by Benson Carlin, Circo Ultrasonics Corp., developments of ultrasonics in cleaning, welding and signaling applications were discussed and shear and longitudinal wave forces were explained.

Earlier this year members toured Martin-Denver facilities and saw the tooling equipment involved in production of the USAF Titan ICBM. A visit to the missile's test stand climaxed this highly interesting and informative evening. —*Alan T. Montgomery*

One of Martin-Denver's end products, the Titan ICBM, stands on its launch pad at Cape Canaveral, Fla., in the final seconds prior to flight.

Temple University Chartered

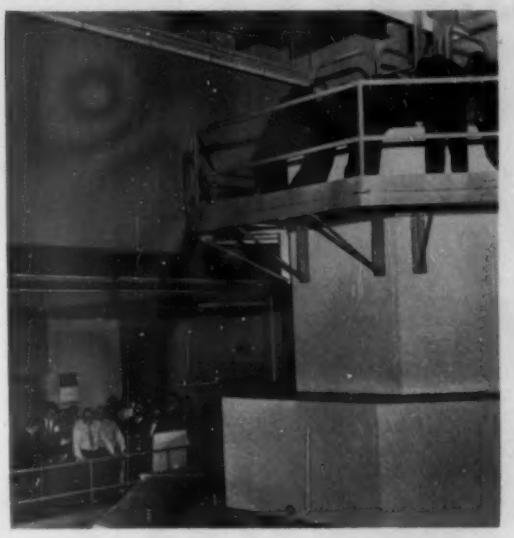
Robert H. Creamer (far left), faculty adviser, and Dr. William A. Schrag (third from right), dean of the Community College and Technical Institute, join Gilbert Seeley, Oliver S. Hulley, George Rosenberry, Robert Lambert and Robert Homan, prominent participants in T. U.'s chartering ceremonies.

PHILADELPHIA, Pa.—At a recent chapter chartering a group of 30 Temple University students became the 37th ASTME student chapter. Oliver S. Hulley, chairman of the National Education Committee, conducted the ceremonies and Gilbert E. Seeley, national education director, presented the new chapter with the traditional headquarters gift. Slated to guide the chapter during its first year are: Robert Homan, chairman; George Rosenberry, first vice chairman; Robert Lambert, second vice chairman; Francis Baldino, secretary; and Joseph Miller, treasurer. —*A. Richard Wallace*

Uranium, Concrete and Water

MADISON, Wis.—Dean Kurt Wendt welcomed members and guests of Madison Chapter 75 to a tour of the University of Wisconsin's new nuclear reactor. The reactor consists basically of about eight pounds of uranium-235, a few gallons of water to allow nuclear reactions to occur, and about 30,000 gallons of water and 1,000,000 pounds of concrete to shield personnel from intense nuclear radiation present near the uranium.

After a complete inspection of the reactor, the group heard El Wakil, assistant chairman of nuclear engineering, talk on the various methods of nuclear power. Joining the chapter in its education night program were guests from eight area high schools and officers of the local JETS chapter.—*A.C.Thomas*



Madison chapter gets a bird's-eye view of the UW nuclear reactor. The 10-kilowatt reactor is designed especially for educational and research purposes.

Canoga Park Joins ASTME Family

CANOGA PARK, Calif.—Past National President Wayne Ewing presided at chartering and installation ceremonies which gave ASTME its 173rd chapter, Canoga Park. Proudly displaying a roster of 134 charter members, Chapter 173 will be led by Al Beaumont, chairman; Glen Crider, first vice chairman; Ken Neel, second vice chairman; John Behan, secretary; and Chester Mozzer, treasurer.

Ralph Chrissie, past chairman of Los Angeles chapter, served as master of ceremonies and introduced honored guests, Dick Reeves, who is honorary sheriff of Reseda, and Francis Lederer, who is now serving as honorary mayor of Canoga Park.

—Glen B. Crider

—Photo courtesy of Western Machinery

Rudy Regen (center), member of the National Program Committee, congratulates Al Beaumont, chairman of Chapter 173, as Wayne Ewing looks on.

Catskill Members Tour Rotron Plant

CATSKILL REGION, N. Y.—In a brief address which welcomed members of Catskill chapter to a tour of Rotron Mfg. Co., Inc., of Woodstock, N. Y., J. C. vanRijn, president of the company, said that this was the first time the facilities had been made available for such an extensive inspection. As a prelude to the tour, Charles Raibel, superintendent of the plant, presented some technical aspects of the company's operations.

Observing techniques utilized in the design and manufacture of precision motors and instrument ventilating fans, Catskill members saw motor assembly, painting, testing, and motor coil winding. Of particular interest to the group were specialized inert gas welding and centrifugal casting operations.

—Kenneth Sandberg

special events

On-Campus Conference "Manufacturing for Competitive Markets"	Oct. 7 1961	Dominican College Racine, Wis.
ASTME Semiannual Meeting	Oct. 26-27 1961	Royal York Hotel Toronto, Canada

Fond du Lac Hosts Engineering Students

FOND DU LAC, Wis.—Some 213 senior high school engineering students from the northeast Wisconsin area, and their counselors, were guests of Fond du Lac for the chapter's Annual Student Guidance Day. The students and counselors, accompanied by 22 Fond du Lac members, were taken on guided tours through the Cleereman Machine Tool Co. and the Hudson-Sharp Machine Co., both of Green Bay. In the evening a dinner meeting was held and Dr. Robert Brooks, chairman of St. Norbert College Sociology Dept., spoke to the group on higher education.

Chapter 45 planned the day's events for the student—to help guide him in his future and to give him a good look at design, research, and development, processing, industrial and production engineering. *—William W. Warren*

Students and counselors who were guests of Fond du Lac chapter for Student Guidance Day listen to a guide at the Cleereman Machine Tool Corp. explain the intricacies of large bearing shafts.

New Haven Cosponsors Lecture Series

NEW HAVEN, Conn.—Using blackboard diagrams, slides, printed sheets and models, Kurt Hain, noted engineer, author and scientist, from Brunswick, Germany, recently presented a public lecture series on the design of mechanisms. Sponsored through the combined efforts of Yale University and local chapters of ASME and ASTME, the five lectures attracted some 200 persons.

Hain, a visiting professor of mechanical engineering at Yale's School of Engineering, explained the design of mechanisms combining cams and linkages. He also pointed out how to find the best linkages for a desired motion and how to incorporate springs within mechanisms. Assisting Hain was Yale's Professor F. R. Erskine Crossley.

—Robert B. Milne

Past, Present, Future

MINNEAPOLIS, Minn.—H. Verne Loeppert (far left) discusses the past, present and future state of tool engineering with Minneapolis chapter officers (left to right), Orville Wineland, secretary; Harland Benson, treasurer; Frank Liljemark, first vice chairman; Art Stockwell, chairman; and Roy Wrassel, second vice chairman. *—Ed Gillaspy*

Detroit Visits Fermi

DETROIT, Mich.—More than 250 members and guests of Detroit chapter viewed this scale model as they toured Enrico Fermi Power Plant in Monroe, Mich. Highlights of the evening were a close look at the plant's atomic reactor and an address by Lowell Roe of Toledo Edison's engineering staff. *—G. Robert Frieling*

Lansing Chapter Sets Fast Pace

LANSING, Mich.—With new officers and a stimulating 1961-62 agenda, Lansing chapter has embarked on an interesting and educative year. Recently, the group presented $100 scholarships to two outstanding Lansing area high school seniors planning to continue their education in mechanical engineering.

Earlier this year two noteworthy programs were presented. The first featured Arthur B. Wiese, an engineering sales administrator from The Gilman Engineering and Mfg. Co., who talked on the automated assembly line. The following month the chapter toured AC Spark Plug.—*Glenn L. Crippen*

Reports in Brief . . .

Northeast

At a spring meeting MONADNOCK members heard New Hampshire's Gov. Wesley Powell talk on the state's industrial growth. Powell told the chapter that New Hampshire now rates second in the fifty states for per capita industrialization. . . . Albert P. Goeppert of Adamas Carbide Corp. was the guest speaker at a recent MONMOUTH technical meeting. He spoke on the diagnosis and correction of tool failure.

West Coast

SANTA ANA chapter recently held its annual combined Ladies and Junior Engineers Night. Highlight of the evening was the presentation of awards to three outstanding high school students, and a scholarship of $100 to J. Elbert Lowler, who is attending the University of California. Featured speakers were Bruce McIntyre and Stan Comer.

Australia

Following the presentation of the Engineering Citation to John Finlay, Sr., SYDNEY chapter heard Cedric A. Wylie of the Small Arms Factory, Lithgow, speak on broaching. . . . Philip A. Marsilius, ASTME vice president, was feted by MELBOURNE chapter at a dinner given in his honor. Marsilius was in Australia representing the machinery section of the U. S. Trades Commission.

Midwest

A special panel discussion, "Tooling—Make or Buy," highlighted a recent meeting of ST. LOUIS chapter. The session closed with a lively discussion period. . . . WICHITA has had a busy spring. Maintaining their pace as an active chapter, they sponsored their third annual Production Institute, and had Robert Kostur, vice president of Comet Industries, as guest speaker for the following meeting. Kostur addressed the group on aspects of vacuum forming plastics. . . . UNIVERSITY OF KANSAS student chapter officers for the coming school year will be: Roy Knapp, chairman; Don Swenson, first vice chairman; James Straight, second vice chairman; Merle Engle, secretary; and Ed Phillips, treasurer. . . . Francis A. Cuthbertson, director of production engineering at AC Spark Plug, recently spoke to RACINE chapter on the methods engineering approach as developed by General Motors. . . . Meeting with the American Rocket Society for a joint session, KALAMAZOO chapter heard a talk on rocket manufacture and operation by Robert Kenyon of Chrysler Corp. . . . Aeroquip Corp., Jackson, Mich., played host to ANN ARBOR chapter at a dinner and plant tour meeting. A film, which supplemented the tour, demonstrated some problems in maintaining short-run production to exact and rigid specification. . . . Using cutaway samples and a laboratory experimental model, L. E. Batz, an engineer at AC Spark Plug, acquainted FLINT JUNIOR COLLEGE student members with many technical aspects of the gyroscope. New Flint student chapter officers for the coming school year are: Bruce Hyde, chairman; David Durish, first vice chairman; Donald Lauderbaugh, second vice chairman; Laurence St. Onge, secretary; and Jerry West, treasurer. . . . Automation in Russia was the subject of Nevin Bean's recent speech at a combined meeting of DES MOINES ASTME and AIIE chapters. Bean, who is with Ford Motor Co., was a member of an industrial team which visited the Soviet Union. . . . Cemented carbides, their history and manufacture, highlighted a recent program at CANTON chapter.

position wanted

CUTTING TOOL SERVICE ENGINEER—Age 43, employed at present. Desires full-time position in Detroit vicinity. Twenty-six years' experience includes toolmaking, machine tool building, tool design, die design, tool trouble shooting and tool analyst. Prefer position with cutting tool company handling carbides. Experience includes 11½ years with large cutting tool company. Completed course in tool engineering at University of Detroit. Contact William Jekot, Phone LU. 4-8274, 8156 Cheyenne, Detroit 28, Mich.

VR-65 faces stainless steel plate to 3-5 micro-inch finish for Goulds Pumps, Inc.

Grade VR-65 is maintaining a 3 to 5 micro-inch finish with superb tool life on a "316" stainless steel thrust plate for Goulds Pumps, Inc., Seneca Falls, New York. This very high "grind" finish is necessary to prevent excessive wear on the graphite part that bears against the plate in Goulds "Nuclear Canned Pump."

The plate is faced at 1220 rpm on a Hardinge Precision Chucker. The sfpm is 300 at the $1\frac{5}{16}$" inside diameter and increases to 765 at the $2\frac{3}{8}$" outside diameter. Feed is .0009" per revolution and depth of cut is .003". VR-65 produces twice as good a finish in half the time with six times longer tool life per grind than the previous method.

Performance such as this puts VR-65 in a class by itself. On your next machining problem, ask your V-R representative about VR-65 or other cutting tools in V-R's complete line.

CREATING THE METALS THAT SHAPE THE FUTURE

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Progress in Production

HAND TOOL IMPROVES MISSILE RELIABILITY

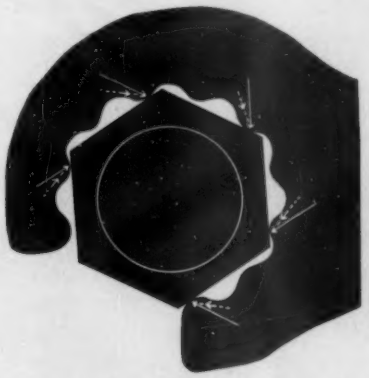
Leakage of tube fittings is believed to be one of the major causes of missile failure. Several missile manufacturers have reported that the tools used to tighten fittings make it virtually impossible to obtain an absolutely leak-free connection. Conventional wrenches tend to distort fittings, actually extruding and bending the metal into an oval shape that results in leakage. Distortion during tightening also leads to erroneous torque readings. Excess friction from binding and crushing increases torque by some 75 percent in many cases.

For these reasons, manufacturers are constantly trying out special fastening tools designed to eliminate fitting distortion. Excellent results have been obtained with TKF Co.'s Cam-Loc wrenches, which utilize a new tightening principle. As shown in the drawing, the Cam-Loc wrenches apply pressure at five points, a feature that equalizes torque. Conventional wrenches apply pressure to the turning member with a flat surface against the very corner of the hex and at an angle. This causes a wedging action that leads to distortion and jamming.

Cam-Loc wrench is used to tighten tube fittings. Equalized torque presents fitting distortion, eliminates leak.

The Cam-Loc principle makes it possible to correct, as well as prevent, leaks. When a fitting that has been tightened with a standard wrench is loosened with a Cam-Loc, the fitting, if distorted, is brought back into round. It can then be easily removed and replaced or simply tightened down, thus eliminating the leak.

Automobile manufacturers are now using the new tightening tool for original assembly maintenance work on the hydraulic systems of cars and trucks. It is also being used in a major laboratory that specializes in the design of advanced servomechanisms and automatic controls, where it has solved several "impossible" leakage problems.

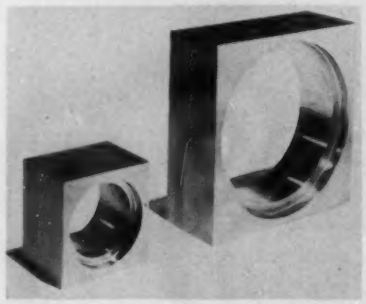


Design of new tightening tool provides five-point pressure on hex nut. Dotted lines indicate direction of force as pressure increases.

POWDER METALLURGY PROCESS PRODUCES NUCLEAR ALLOY

Zirconium base alloys—because of their low neutron cross section, good mechanical strength, heat resistance and excellent corrosion resistance to high temperature steam—are being put to work in the nuclear industry as fuel element cladding, structural parts and supports. One of these alloys, Zircaloy 2, is produced by a powder metallurgy process.

The process is a modified vacuum hot pressing technique which provides several important advantages over conventionally produced material. First, it produces finished or semifinished shapes which require little or no machining. This avoids long hours of costly machining and also eliminates the loss of many pounds of valuable starting material. Second, the material has outstanding physical characteristics that



Finished and semifinished shapes, produced by the vacuum hot pressing powder metallurgy process, require little or no machining.

are normally associated with a wrought product. Its density is 6.57 gms/cc. Third, it is free from porosity and its gas content meets nuclear specifications. Fourth, the properties are nondirectional, eliminating the need to compensate for directional weakness. A fifth advantage of the process is in dispersion strengthening and hardening, impossible by casting techniques since the oxides either segregate or float off the molten mix. The sixth advantage is that two metals which are dissimilar can be bonded together by diffusion.

Zircaloy 2 is made by the Metallurgical Products Dept. of General Electric Co., Detroit, Mich. The process used for its manufacture is suitable also for refractory metals such as columbium, tantalum or their carbides.

ADHESIVE BONDING CUTS COUNTER COSTS

Use of adhesive bonding for assembling various components to hydrocarbon fluid metering counters has improved manufacturing techniques and substantially reduced production costs

AUTOMATIC BRUSHING SETUP buffs mirror finish on 12" wrench parts for plating. Multiple parts are mounted in special removable fixture. Machine automatically positions and oscillates parts between brushing heads for 25 strokes per cycle. Each head is made up of 65 Osborn Bufcut® treated cord brushes.

MIRROR FINISHING wrenches nine at a time with OSBORN power brushing

This leading tool manufacturer uses Osborn power brushing to buff a mirror finish on forged steel wrenches, pliers and chisels before plating.

Pre-mounted in multiples on removable fixtures, the tool parts are buffed in a special machine which automatically lowers and oscillates the parts between two Osborn Bufcut® brushing heads. The operation is simple, fast, inexpensive. This method has been in continuous use in this plant for nearly 12 years—*still proves to be the best way to do the job today.*

It's a typical example of how Osborn power brushes and brushing methods—through years of exceptional, dependable service—are handling industry's tough metal finishing jobs. If you have a metal finishing problem—deburring, cleaning, polishing, precision blending—an **O**sborn **B**rushing **A**nalysis, made in your plant at no obligation, can pinpoint the answer. *Write or call The Osborn Manufacturing Company, Dept. K-69, Cleveland 14, Ohio. Phone ENdicott 1-1900.*

OSBORN

Metal Finishing Machines . . . and Finishing Methods
Power, Paint and Maintenance Brushes • Foundry Production Machinery

Use Reader Service Card, CIRCLE 86

at Ralph N. Brodie Co., San Leandro, Calif. Examples of these parts are metal inserts, extension covers, nameplates and dial glass.

Bonding a metal name and instruction plate on the slot cover of the counters has made possible a cost-saving material change and the elimination of drilling operations. In attaching the name and instruction plate to the front cover, the adhesive is applied by a pressure flow gun and the nameplate —previously installed with eight drive screws—is pressed into position. A frame ring and seven screws formerly used to hold the dial glass in place and two inserts which were assembled to each base with screws and lock washers have been replaced with the adhesive bond.

The fast-drying, high immediate strength elastromeric adhesive has excellent resistance to oils, fuel and other aliphatic hydrocarbons. It provides high ultimate strength on a variety of surfaces and can be used to bond metals, glass, wood, leather and many types of vinyl plastics and rubber. It is made by Minnesota Mining and Mfg. Co., St. Paul, Minn., and meets Military Specification MIL-C-4003.

BALL SPLINE ADDS RIGIDITY TO BALL SCREW MECHANISM

Using a ball spline in conjunction with a ball screw solved a major problem for Beaver Precision Products, Inc., Clawson, Mich. This particular application demanded the highest possible percentage of efficiency in actuation and sensitivity in positioning control. Because of the diameter-to-length ratio, however, deflection resulting from side thrust and torque was anticipated in the ¼-inch-pitch-diam, 48-inch-long ball screw involved.

A 2½-inch-diam ball spline met the problem and counteracted deflection. The nuts of both the screw and spline were encased and preloaded in a single cast aluminum housing which tied the screw and spline together as a unit. In this way, linear loads were taken by the screw, the small diameter of which minimized inertial drag, and lateral and torsional loads were reacted in the spline.

This screw-spline actuator provided elevation and azimuth adjustment of a B-58 Hustler Doppler antenna test facility developed by Raytheon. Previously the test was performed by installing it in a plane and checking it out in flight. The ground facility now performs the test in a 100-ft-long tunnel with error reduced from 1 to 0.1 percent.

TOOLS of today

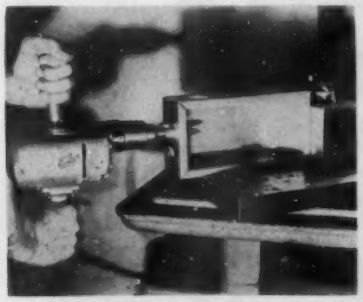
Device Detects Press Overload

Available as part of a system for preventing damage to dies on power presses, transfer machines and other automated production equipment is an adjustable press overload detector. This electrically controlled system disengages the press clutch in the event of misfeed, stock buckling, material pile-up or coil and within one cycle. The control operates on any size press with either friction or mechanical clutch.

Di-Matic Controls, Inc., 100 Beadel St., Brooklyn 22, N. Y. **Circle 401**

Cone Drill Produces Varied Hole Diameters

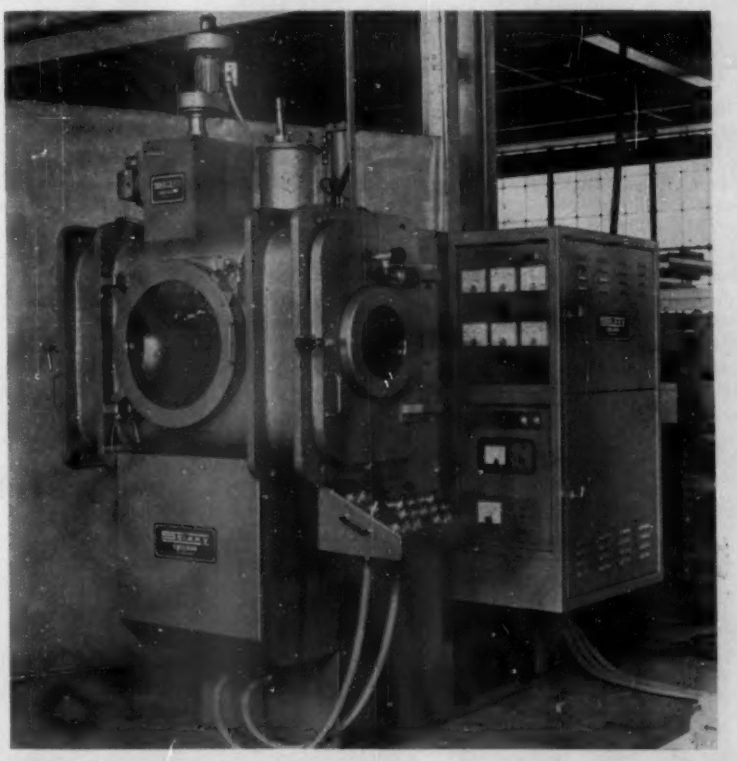
This cone drill produces hole sizes from ¼ to 1¼ inches in diameter in metal, plastic or other relatively thin material. It eliminates circular hack sawing or knockout punching in sheet metal work. Because it has a 7/32-inch-diam drill point, center drilling or punching is unnecessary. Its ability to remove a continuous chip and leave no burr inside the hole after drilling elimi-



nates subsequent finishing operations. The drill can be used in power tools of ½-inch drill capacity and in drill presses and similar machines at speeds from 500 to 600 rpm.

Scully-Jones and Co., 1924 S. Rockwell St., Chicago 8, Ill. **Circle 402**

Electron Beam Welder Welds at Any Angle

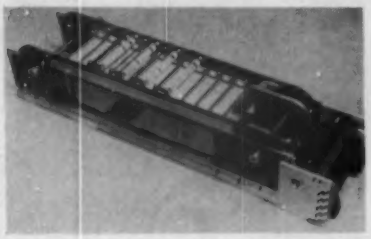


Pictured here is an electron beam welder, Model VX-20-30-48, used in welding various refractory and reactionary metals as well as dissimilar groupings. Its vacuum chamber measures 20 x 30 x 48 inches. The electron gun has traverse and vertical motion, powered by a speed and position servo control. This control also effects longitudinal motion to the internal worktable. An electron beam of 350 ma at 30 kv can be produced by the electron gun. The beam spot can be focused into a 0.030-inch minimum diameter and over a 1.0-inch maximum diameter.

Sciaky Bros., Inc., 4915 W. 67th St., Chicago 38, Ill. **Circle 403**

Automatic Control Sorts Conveyor Information

Package sorting, assembly line deliveries, warehouse routing and conveyor delivery of manufacturing components are among the applications of this compact sorting control. Called RSC, the unit is actually a scaled-down version of the conveyor to be controlled, containing sets of code wheels representing the carriers, and stationary code bars in place of terminal receptacles of the main conveyor. The code wheels of each set have a left and a right position and travel over coded tracks consisting of code bars which also have



right and left positions.

As an item is placed into a carrier on the main conveyor, it is routed to a particular destination by having this destination information coded into the set of code wheels corresponding to the carrier involved. As the item moves along the main conveyor, the associated set of code wheels moves on its coded tracks in the unit at a rate such that when the carrier reaches its proper discharge location, the associated code wheel set is superimposed upon its complementary bar set. At this point, the code wheel set dips into the track, initiating a signal for the carrier to discharge its contents. The code wheels are reset at the end of each conveyor cycle and the control operation is repeated.

Each track set can be coded at any time to correspond to any specific discharge location by shifting bars from left to right positions. The unit is available with 4, 6, 8, 10 and more code wheels a set to give 16, 64, 256, 1024 and more sorts.

Rabinow Engineering Co., Inc., 7212 New Hampshire Ave., Washington 12, D. C. **Circle 404**

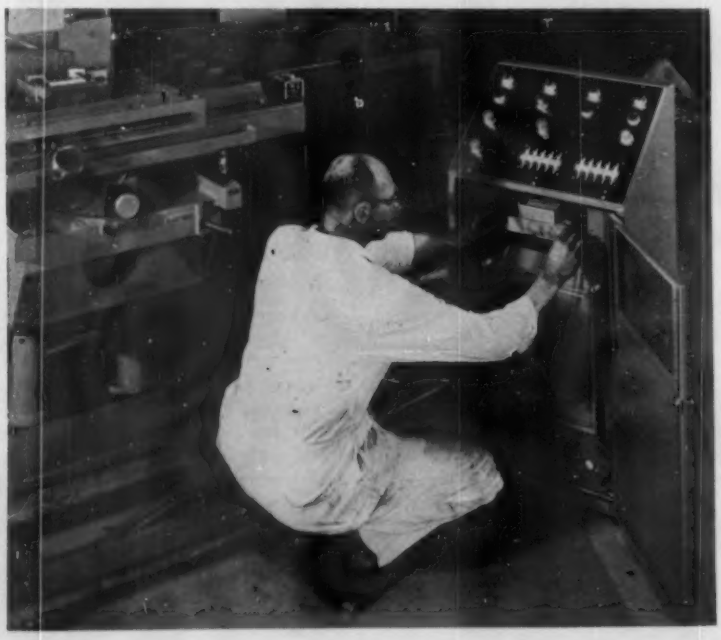
Point-to-Point Control For Drilling Machines

Based on pneumatic-hydraulic principles, the Hydra-Point tape-reading numerical control system provides point-to-point positioning for drilling and tapping and for straight line milling operations. It can be applied on new machines or on existing drilling, tapping and boring machines.

A pneumatic block tape-reader is used to read coordinate and auxiliary instructions from a standard 1-inch, 8-channel punched tape. Signal air pressures from the reader are amplified hydraulically and used to position two sets of decoder switch plates on each of two actuators. One set of plates selects one of a number of holes spaced at 0.1-inch intervals along the axis of the actuators. The selected hole acts as a valve port in a hydraulic 3-way valve controlled servomechanism. The other set of plates selects one of a hundred holes equally distributed along the circumference of a rotary actuator. The rotary actuator establishes the angular position of the helical valve land of the hydraulic servo, thereby achieving a position increment of 0.001 inch.

The system positions the table at speeds of 350 to 700 ipm and achieves positioning accuracy of ±0.0005 inch. Tape preparation equipment such as the Flexowriter can be used in programming.

Moog Servocontrols, Inc., East Aurora, N. Y. **Circle 405**



Portable Unit Aids Maintenance Balancing

One of the applications of the Masterline portable balancer is its use by machine manufacturers to check rotating assemblies where vibrations need to be isolated, located, measured and corrected. Incorporating building-block design and selector switch, it is available in four different amplifier and control unit combinations. Vibration

amplitudes as small as 0.000025 inch can be measured. The units are completely transistorized and use printed circuits. Each unit contains a filter for minimizing the influence of other vibrations. Operating speed increments within a range of 300 to 150,000 cpm can be covered.

Gisholt Machine Co., Madison 10, Wis. **Circle 406**

NC System Has Cutter Compensation

With the cutter compensation system —an option on the DynaPath-20 series numerical contouring controls—it is possible to machine accurately with cutting tools varying as much as 0.050 inches from the programmed diameter. This permits the machine operator to use reground tools or to make both roughing and finishing cuts with the same tool and the same tape. Because a secondary signal which is superimposed on the command signals which operate the machine's servo drives is generated, the required correction is proportioned to each axis, producing a normal offset regardless of the direction or curvature of the cutter path. Two controls are mounted on the operator's console with which he indicates the difference between actual and programmed cutter size and the direction in which the compensation is made.

Bendix Corp., 21820 Wyoming, Detroit 37, Mich. **Circle 407**

USE READER SERVICE CARD ON PAGE 123 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

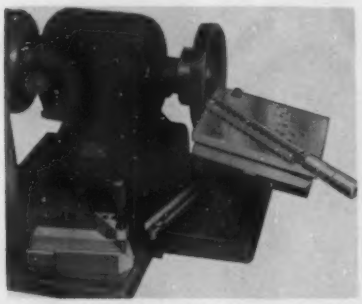
Boring Device Handles Miniature Parts

Developed for the instrument and small parts industries, this miniature boring spindle assembly has boring speeds ranging from 1000 to 15,000 rpm. A reciprocating boring spindle with up to 2 inches of axial travel, it has a rotational error of less than 0.00003 inch and a travel error of less than 0.00005 inch in its entire range of travel. Equipped with micrometer depth control, it repeats to within 0.0002 inch, with infeed, controlled boring feed and dwell time all variable. By using several units as nodules or building blocks mounted on a surface plate, multidirectional miniature boring machines can be assembled and revised for changing needs.

Whitnon Mfg. Co., Rte. 6. Britain Ave., Farmington, Conn. **Circle 408**

Fixture Simplifies Gun Drill Nose Grinding

Grinding gun drill noses is simplified by this rocker base nose grinding fixture for use on any bench or pedestal grinder with a diamond wheel. The fixture has two parts—a rocker base that is set on the grinder's angle table and

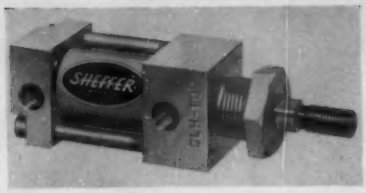


a block for holding the gun drill securely on the fixture. The rocker takes care of the traverse for grinding. Two types of drill holding blocks are available. A micrometer block with micrometer stop accommodates drills of from one-fourth to one inch diameter. Individual blocks, for specific sizes of gun drills, are available for sizes with diameters between 0.078 and 1 inch.

Eldorado Tool and Mfg. Corp., 342 Boston Post, Milford, Conn. **Circle 409**

Stud Mount Cylinder Has Air, Hydraulic Uses

This stud mount double-acting or spring-return clamp type cylinder measures 1⅝ inches on each side. It is rated at 250 psi for air pressure and 1500 psi for hydraulic pressure applications. The piston rods are of 110,-



000 psi tensile strength steel and the cylinder tubes are of drawn brass. Mounting can be done from the front or rear heads or from the side.

Sheffer Corp., 326 W. Wyoming Ave., Cincinnati 15, Ohio. **Circle 410**

Bronze Coatings Aid Piston, Rod Lubrication

Reduced costs for bushings and rod replacements and decreased downtime are two results of using Bronze Case rod material in combination with hardened steel bushings for piston and guide rods and similar linear applications. The combination also eliminates rust and nick problems.

Instead of being confined to the bearing area within a bushing, bearing bronze is fused on the large area of

For { 8-STATION PRODUCTION MACHINING
1½" BAR AND COLLET WORK
CHUCKING
SINGLE POINT THREADING

Costs { $7,167.00 FOB Factory Complete with all standard equipment

This is an all new 1½" bar capacity ram type turret lathe with power feeds to all 8 working stations . . . that in addition to bar and collet work also has the versatility to do chucking, and when needed, single point threading. Powered by a 5 h.p., two-speed, geared motor, the new Sheldon 3 R turret lathe provides 16 spindle speeds, 60 different feeds to the carriage and cross-slide, and 180 different feeds to the ram turret.
The turret itself is ruggedly built and accurately machined to provide close tolerance indexing. And for complete ease of operation, it is put under power by simply pressing a push button on the control panel.

This new 3 R Sheldon is completely equipped with two-speed motor and electrical controls, coolant system and splash guards, LO spindle nose, large satin chrome dials and hardened bed ways. It also provides an additional cost saving feature—each turret face is drilled and tapped for your standard flange type tooling as well as being bored for your standard 1½" shank type tooling.
For versatile, accurate machining in either long or short runs, the new Sheldon 3 R provides the answer to low investment cost with high profit operation.

New SHELDON
3R-TURRET LATHE

Write for bulletin with complete specifications and tooling data

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the shaft, ground, and straightened to close tolerances. Done by a high-temperature spraying operation, the fusing forms a coating of controlled porosity for high lubricant retention. Lubricants do not wipe off and the amount of lubricant stored is increased since it is stored over the entire shaft surface.

In conventional reciprocating applications, wear is concentrated on the short length of bearing material within the support bushings. The effective bearing length is increased by the length of stroke and wear is spread over a large area.

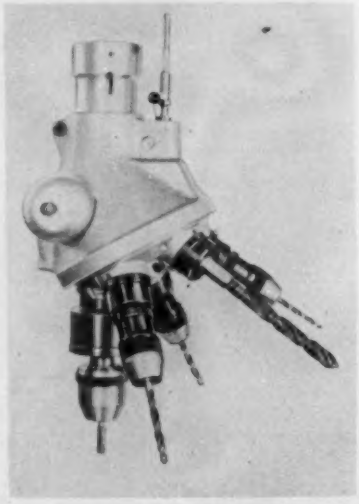
Bronze case rods are of heat-treated AISI 1060 steel. The diameter tolerance up to 2 inches is +0.0000, −0.0005 inch and, for 2 inches and over, +0.0000, −0.0007 inch.

Thomson Industries, Inc., 1029 Plandome Rd., Manhasset, N. Y. **Circle 411**

USE READER SERVICE CARD ON PAGE 123 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Drill Head Handles Five Tools at Once

With this automatic indexing turret type multispindle drill head, any vertical single-spindle drillpress can play a double role as a multispindle drillpress. Named the Arbo-3, the unit takes

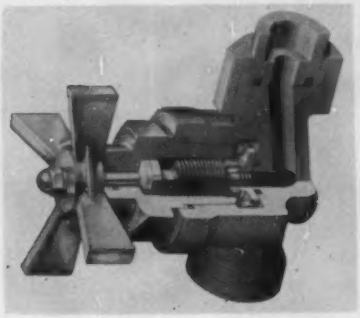


two to five tools at one time. All spindles are completely and quickly interchangeable. Eight independent speeds are available. Its drill capacity is from ⅛ to 1 inch and its tapping capacity from ⅛ to 15/16 inch.

Jersey Mfg. Co., 401 Livingston St., Elizabeth, N. J. **Circle 412**

Valves, Fittings End Leakage, Add Versatility

Combining features of soft-seated valves and O-ring fitted connections and unions, the CPV O-Seal System offers leakproof versatility for handling liquids and gases at pressures to 6000 psi and

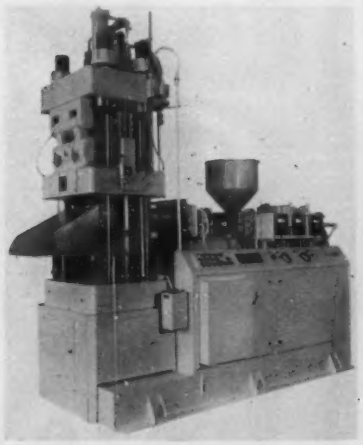


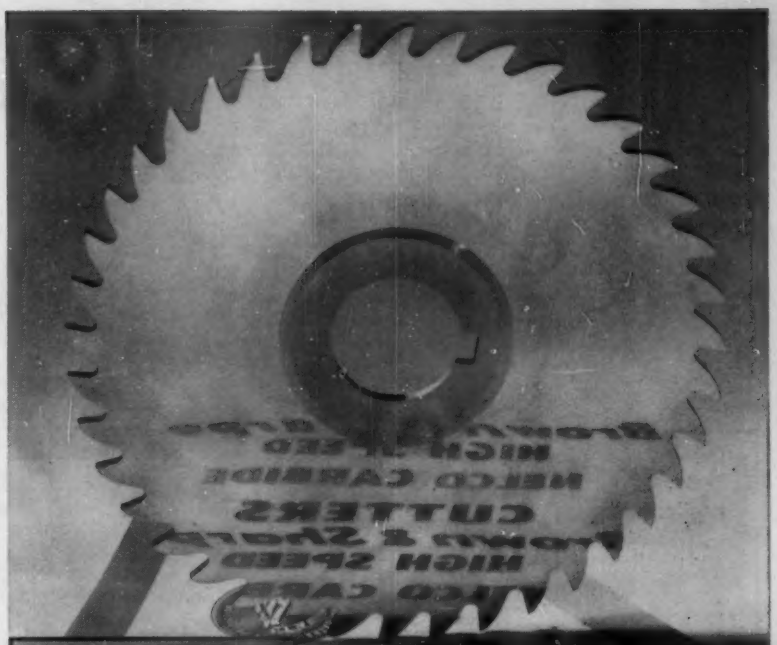
temperatures from –20 to 275 F. The heart of the valve is the resilient nylon disk which deforms and assumes the surface of metal seat, assuring positive valve shutoff. A Teflon thrust washer and O-ring stem seals eliminate the need for valve packings. These valves and fittings are available in pipe or tubing sizes from ⅛ through 2 inches in either of two pressure classes—6000 psi series or 1500 psi series.

Combination Pump Valve Co., 846 Preston, Philadelphia, Pa. **Circle 413**

Injection Molding Press Requires Less Heat

This 12-oz automatic injection molding press, Model 706, incorporates a screw plasticator which eliminates the customary thrust-bearing through which hydraulic ramming pressure is applied to the screw. A straight shaft links the screw in the plasticizing cylinder with the piston in the ram cylinder, which is located directly behind the cylinder and on the same axis. The screw is driven by a hydraulic motor mounted





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The mirror-like finish of new B&S "Sawperior" slitting saws mark 3 new developments that more than double production and make other saws virtually obsolete!

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Shop tests prove the new tooth geometry and mirror-like finish give up to 4 times as much slitting production between sharpenings.

Super finish on sides permits use of less concavity or side clearance thereby providing a stronger saw section and a stiffer, more accurate saw.

Smooth side finish resists scratching, resists corrosive action of coolants and rust.

New saw design requires less milling machine power thereby allowing heavier cuts without strain or chatter.

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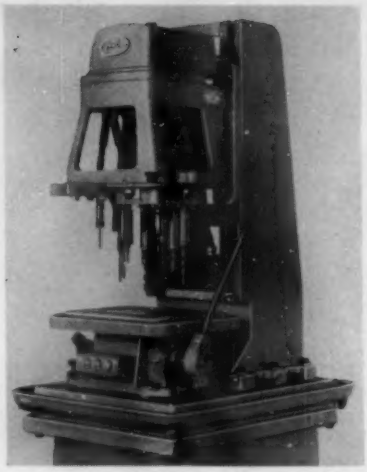
directly above the shaft and the shaft moves axially forward and back through the gearbox as the screw advances or retracts. The hydraulic motor provides infinitely variable speed control and protection against torque overload. Because the screw plasticator substitutes mechanically-produced heat for a large portion of the electrical heat required in earlier injection cylinders, the material is thoroughly plasticized and completely homogenized, and can be injected at lower pressures.

F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa. **Circle 414**

USE READER SERVICE CARD ON PAGE 123 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Machine Drills, Taps Small Parts

Primarily for small parts products, where small hole drilling and tapping is required, the completely self-contained Dril-King stands 66 inches high

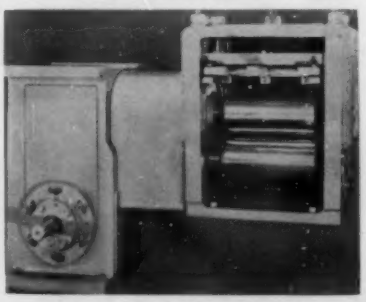


including the base. It has 12 spindle drivers and is able to work at center distances down to 3/8 inch minimum. Work area of this drilling and tapping machine is 6 x 8¼ inches. Powered by a V-belt drive allowing four speed changes, the unit has a vertical feed worktable that brings the work up to the head rather than the head coming down to the work.

Jarvis Corp., Middletown, Conn. **Circle 415**

Roll Feed Stops Stock Slippage

Consisting of a roll assembly with rolls coupled to the cam indexing mechanism, the Camtrol roll feed unit combines controlled stock with roller gear drive indexing to achieve feeding at rates over 3000 ipm. The lower roll is driven directly by the roller gear drive which provides positive stopping instead of frictional braking. The upper



roll is powered through gears permanently installed in the roller gear housing. The design is such that the roll assembly is self-adjusting for variations in stock thickness with the pitch line of the gears remaining in location to assure rotation of both rolls with constant velocity. Strokes up to 6 inches are available.

Ferguson Machine Co., St. Louis 17, Mo. **Circle 416**

ALL IN ONE PACKAGE

Oberg Programs a package that includes the designing, engineering and building of a single or series of Carbide Dies—also the auxiliary tooling, if required.

But that's not all! If requested, an Oberg Engineer directs the installation of the Die in the customer's plant . . . *after* it has been production-proved and the operating personnel have been trained in its use and maintenance at the Oberg plant.

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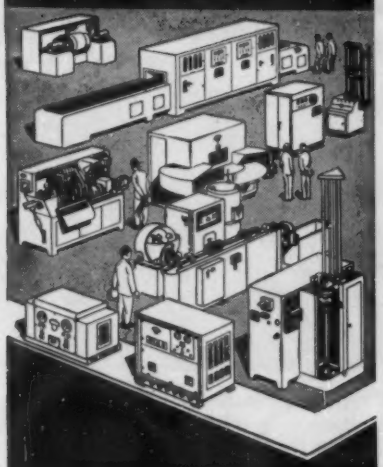

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Self-Contained Chuck Has Open-Center Construction

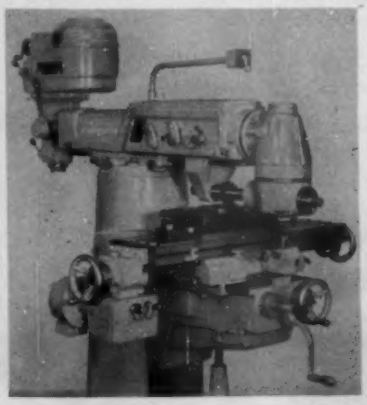
This air chuck, because of its open construction, allows the workpiece to be passed entirely through the center of the chuck body. No external air cylinders or draw rods are necessary. The need for permanently attached air supply lines is also eliminated because once the air supply is applied to the

inlet valve located on the chuck body, the chuck jaws are activated. The chuck can rotate, move axially or travel in any manner. The construction of the annular ring piston results in self centering of the workpiece within a tolerance of ±0.002 inch total indicator reading. Provided with a 7/8-inch movement per jaw, permitting 1¾-inch diametrical movement, the chuck is available with inside diameters from 12 to 48 inches.

Molenberg-Betz Machine Co., Inc., Buffalo 2, N. Y. **Circle 417**

Milling Machine Does Horizontal, Vertical and Angular Work

This turret type milling machine has a spindle head designed for horizontal milling with arbor mounted cutters and for vertical and angular milling with the spindle head swiveled and the arbor



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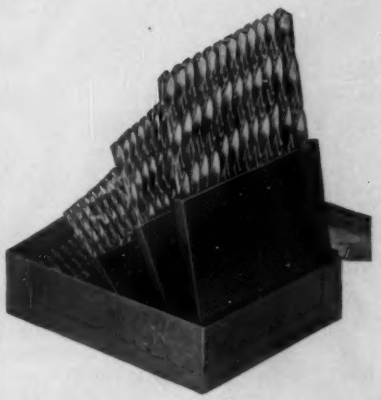


ACE DRILL SETS

Standard stock sets include Fractional, Wire and Letter size drills, packaged in convenient folding index cases.

ACE BLANK SETS

Uniformly hardened high speed steel reamer and drill blanks precision ground to new close tolerance limits available in standard Fractional, Wire and Letter series sets.

Call your local distributor today—or write Ace direct for latest catalog and price information.

ACE DRILL
Adrian, Michigan

ORIGINATORS OF "GROUND-FROM-THE-SOLID" DRILLS

Use Reader Service Card, CIRCLE 93

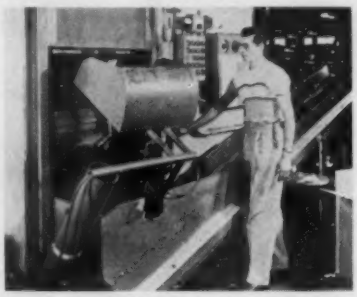
support removed. Any of three vertical heads can be mounted on the opposite end of the overarm. Change from horizontal to vertical or angular milling is accomplished by loosening four bolts and swiveling the overarm and turret base as a unit to locate the vertical head over the table. An addition to the Toolmaster line known as H-V, the hand-feed machine has eight spindle speeds.

Cincinnati Milling Machine Co., Cincinnati 9, Ohio. **Circle 418**

Machine Deflashes Molded Rubber Parts

Shown here is a rubber deflashing machine—the basic unit of an impact mechanical process for deflashing molded rubber parts. Readily adapted to parts with flash that does not exceed 0.005 inch at the point where it is attached to the part and capable of deflashing parts with thin part sections so long as the wall thickness is no smaller than 0.015 inch, the process completely eliminates hand labor.

Parts are introduced into the 2-cu ft work chamber and sprayed with liquid CO_2 to freeze the flash on the parts. Next, media particles are hurled by centrifugal force against the parts, fracturing and removing the frozen flash without damage to the soft unfrozen parts. The parts are carried by a conveyor. A dust collector ventilates the



operation and removes impurities from the media supply.

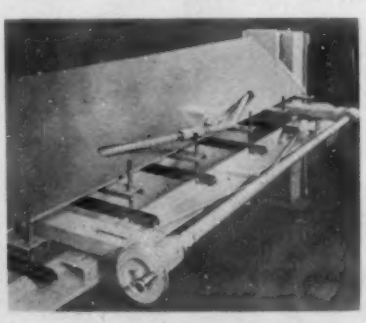
The media hurling device has speeds up to 3000 rpm. Particles are spherical steel pellets within a size range of 0.007 to 0.017 inch in diameter and with a nominal size of 0.011 inch. The wheel unit can hurl up to 350 lb of media a minute.

Wheelabrator Corp., Mishawaka, Ind. **Circle 419**

USE READER SERVICE CARD ON PAGE 123 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Magnetic Sheet Support for Squaring Shears

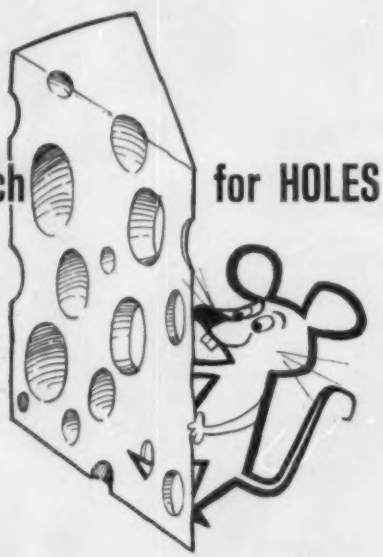
Designed for use when shearing ferrous materials 16 gage or lighter, this magnetic sheet support consists of several sets of magnetized rollers attached to the crosshead of the squaring shear. The rollers grip the material and hold it level to prevent drooping as the sheet passes from the rear of the bed to the



back gage. Holding power of the magnetized rollers is just enough to support the sheet until it is cut. The severed portion falls free instantly.

Niagara Machine & Tool Works, Buffalo 11, N. Y. **Circle 420**

Spending too much for HOLES?



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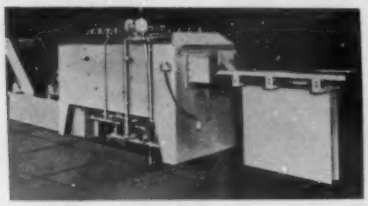
Furnace Has Forced Convection Heating

One feature of this continuous production shaker hearth type controlled atmosphere heat treating furnace is 100 percent forced convection heating of the work. Other features include a preheat vestibule, a two-zone heating chamber and a conveyorized quench tank. Used for bright hardening, carbonitriding and light case carburizing, the furnace provides uniform heating and

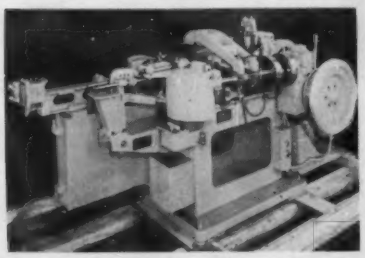


quenching and produces a bright finish on treated parts. Operating at 1550 F, it has a maximum heating capacity of 1000 lb an hour. Heat is created by alloyed ceramic heating tubes.

Ipsen Industries, Inc., Dept. 21, P. O. Box 500, Rockford, Ill. **Circle 421**

4-Slide Machine Reduces Formed Stamping Costs

Outputs of 400 spm are attainable with the Model MS-28-HS Multi-Slide machine for formed stampings. The design of the machine is symmetrical in that the die heads are reversible and can be used from either front or back, giving the advantages of versatility both in operation and in the designing of tools. The machine has high-speed,



positive grip type feed; a stock check and straightener; an automatic lubrication system; and a 5-hp variable speed drive.

U. S. Tool Co., Inc., Ampere, N. J. **Circle 422**

Ultrasonic Degreaser Cleans Plastic Parts

This bench model ultrasonic degreaser was designed to operate with Freon solvent, which is used in cleaning parts containing plastics, metals, elastomers or insulations which would ordinarily be attacked by chlorinated solvents such

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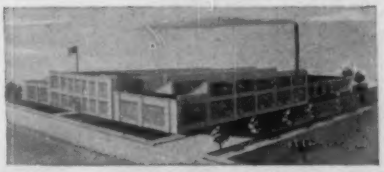

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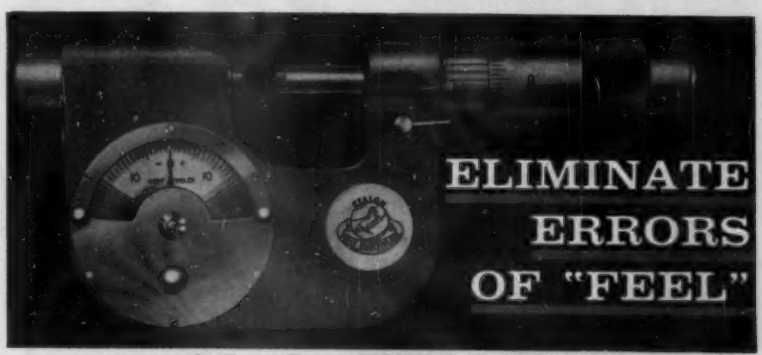

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The micrometer that measures and compares visually!

A rugged instrument designed to combine the precision of a dial indicator with the accuracy of the micrometer screw.

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- To simplify fine adjustment, the dial can be rotated so that the "O" may always be placed under the hand.
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- One piece hardened stainless steel screw.
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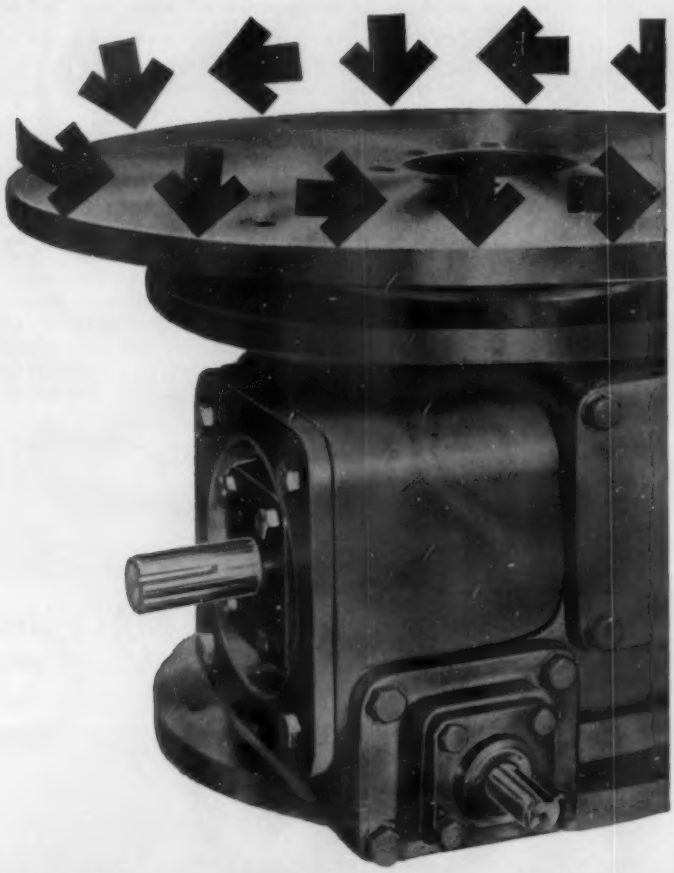

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Standard, Index Units . . . Rotary and Straight-line . . . are designed to be used in machines to provide automatic index motion to fixtured dials and direct mechanical motion to insertion stations, escapements and probes.

Fast, smooth, shock-free indexing is assured by the use of cycloidal cams—with extreme accuracy and at production rates to 6000 per hour.

Standard Model ST-A9AB Precision Rotary Index Unit. For light to medium duty. 4 to 20 stations. Accuracy to ±.0005″ at 6″ radius. Production rate to 6000 per hour.

Standard Model St.-A9B. Heavy duty Rotary. 8 to 24 stations. Accuracy to ±.001″ at 7″ radius. Production rates to 6000 per hour.

Standard Model St-A18 . . . Heavy duty transfer type, straight line unit 27 to 51 work carriers accuracy to ±.003″ production rates 6000 per hour.

Write for complete engineering bulletin, 26-M on Standard Cam-Operated Indexing Units.

MACHINERY DIVISION

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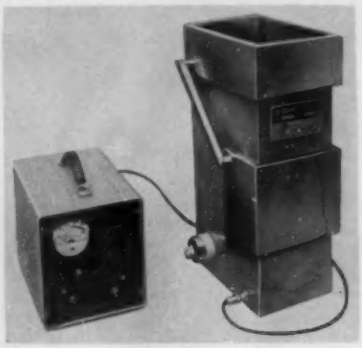
TOOLS of today



as trichlorethylene and perchlorethylene. Parts are first placed in the ultrasonic chamber to remove or loosen all contamination. They are then transferred to the vapor area where they receive a final cleansing in pure distilled vapors. All units are self-distilling, permitting continual reuse of the solvent. They are furnished with a top flange to permit dropping in a bench top for use with a remote generator.

National Ultrasonic Corp., 95 Park Ave., Nutley 10, N. J. **Circle 423**

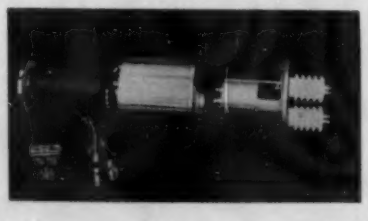
Adhesive Offers High Tensile Shear Strengths

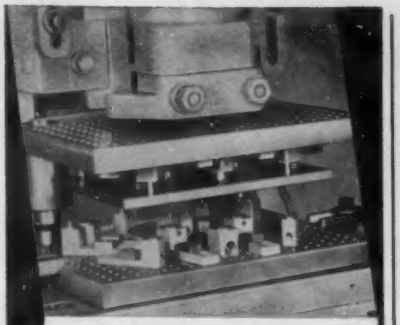
Bonds to aluminum exceeding 5000 psi strength and adhesion to steel, copper, glass and porcelain are possible with Conap 1222 epoxy adhesive. It retains adhesion over a temperature range from —65 to 225 F and after a 30-day immersion in water. The adhesive cures in one hour at 300 F.

Conap, Inc., 184 E. Union St., Allegany, N. Y. **Circle 424**

Electron Beam Heater Welds, Melts Refractories

Among the heating and welding applications of the Series LB-100 electron beam system are melting refractory metals and ceramics, glazing, electronic interconnecting, etching, surface conditioning, encapsulation, microcircuit fabrication and brazing. It can also be used as a general laboratory production device capable of attaining temperatures exceeding 6200 F. It covers a range from 3 kw at 10,000 volts to 9 kw at





Punch Multiple Holes in One Operation with REUSABLE DI-ACRO ADJUSTABLE PUNCHES AND DIES

Di-Acro Adjustable Punches and Dies offer you an inexpensive means of rapid tooling for multiple punching of holes of a variety of shapes and sizes. They will do the job in a fraction of the time it would take using a single station punch press and at a fraction of the cost of standard tooling. All tooling can be arranged in a countless number of patterns so that most multiple hole punching jobs can be accomplished in one operation. Tooling can be reused again and again. Holes can be as close together as ¾" on centers. A template locates your punches and dies accurately. All Di-Acro punches and dies are concentric, readily interchangeable. Standard rounds, squares, rectangles, ovals, D's and other shapes in a variety of sizes are available from stock.

Di-Acro Adjustable Punch and Die catalog is complete with detailed instructions and prices on all die sets, punches and dies. Consult the yellow pages of your phone book for the name of your nearest Di-Acro Distributor or write us for your free copy.

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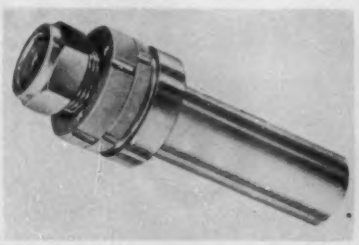
30,000 volts. It is complete and provides magnetic deflection of the beam over a 3-inch-square area, pulsing of the beam energy, regulation of the emission beam over a wide range, and variable focus and focal length.

GVC Electron Heating Corp., Medford 55, Mass. **Circle 425**

Toolholder Compensates For Misalignment

Compensation for both angular and parallell misalignment between the tool and machine spindle is provided by the '09 collet type, full-floating toolholder. It is used in turret lathes, au-



tomatics and radial drills in the horizontal and vertical positions, revolving or stationary. The self-releasing collets used for tool changing have a collapsing range of 1/32 inch and are slotted at both ends. Available in five models in any shank style, the holder accepts collet sizes from ⅛ to 1⅝ inches in diameter.

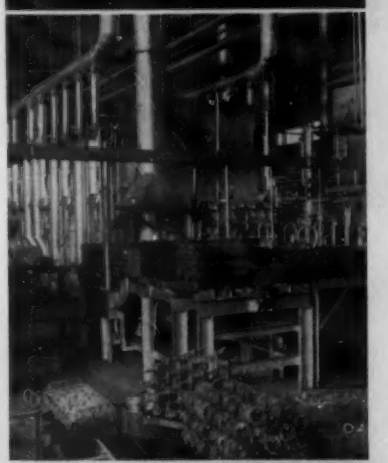
Erickson Tool Co., 34350 Solon Rd., Solon, Ohio. **Circle 426**

Special Cutter Sharpens Hollow Chisels

Tedious filing normally involved in sharpening hollow chisels can be eliminated by cutters used with the illustrated bench type machine. At the bot-

tom of the cutter, a smooth round pilot, which enters the chisel interior, holds the cutter steady and insures a uniform job. It has a double bevel on each

HOLCROFT



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cutting lip. Various cutters are available for sharpening hollow chisels of different sizes. The cutters, developed primarily for woodworking chisels, cannot be used with plastic materials.

Greenlee Bros. and Co., Rockford, Ill. **Circle 427**

USE READER SERVICE CARD ON PAGE 123 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

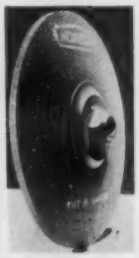
Nylon Polishing Belt Has Long Life

Metalworking, plastics and woodworking polishing operations can be performed with this nylon abrasive belt. It is made by spraying slurry of aluminum oxide or silicon carbide grain and a flexible adhesive on a nonwoven, random fiber nylon web. Next, the web is laminated to a cloth backing and then fabricated into an endless belt. Due to the relatively large openings between the nylon fibers, loading and clogging are reduced and heat generated during polishing is quickly dissipated. The belts available in widths up to 24 inches, conform readily to irregular surfaces and produce extremely high finishes, making subsequent buffing unnecessary in many cases.

Coated Abrasives Div., Armour Alliance Industries, 16123 Armour St., N.E., Alliance, Ohio. **Circle 428**

Grinding Wheel Has Throwaway Mount

For weld grinding and light snagging, the Cut-N-Saucer reinforced grinding wheel has a saucer shaped wheel and a throwaway mount. The saucer shape permits the operator to hold the wheel at a closer angle to the work, resulting in easier control and less operator fatigue.

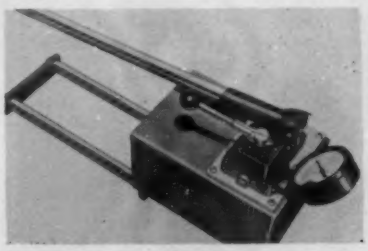


The wheels are available in 7 and 9-inch sizes to fit threaded spindles on portable grinding equipment. The permanently attached Dis-Card mount permits the wheel to be installed on the grinder in seconds. No separate mounting pad is required.

Norton Co., 1 New Bond St., Worcester 6, Mass. **Circle 429**

Hydraulic Pump Handles High, Low Pressures

This two-speed hydraulic hand pump handles high force, high pressure requirements up to 10,000 psi and delivers 7.35 cu. in. per stroke from zero to 200 psi to move the cylinder piston to and from the work. The Dualmaster, Y-29 series, automatically changes to the high pressure stage when a load is encountered, delivering 0.294 cu. in. per stroke from 200 to 10,000 psi. The cover plate, to which pump and valving are mounted, permits the unit to be used with various reservoirs and the



UNBREAKABLE!

This is a punishing test for a hack saw blade. We do it to prove that a Marvel High-Speed-Edge Hack Saw Blade is unbreakable. A Marvel Blade can be bent like this thousands of times and it still won't break.

Why? Because the blade body—to which a high speed steel cutting edge is welded—is made of a tough, non-brittle alloy steel designed to take the heaviest feed pressures and highest speeds any modern hack sawing machine can develop.

What does this unbreakable feature of Marvel Blades mean to you?

1. Operators, knowing they can trust Marvel Blades not to break, tension them truly taut (from 200% to 300% more than ordinary blades) to produce maximum obtainable accuracy of saw cut.
2. They can safely apply heavier feed pressures and higher speeds without endangering themselves or the machine to produce faster cutting-off.
3. Longer cutting life is assured because the blade simply won't break.

Ask for Marvel High-Speed-Edge Hack Saw Blades by name and you can be sure you're getting the unbreakable blades designed to give you maximum accuracy, speed, and safety in your cutting-off operations. Leading Industrial Distributors have Marvel Blades in stock.

MARVEL Metal Cutting SAWS

BETTER MACHINES
BETTER BLADES

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mounting pad on the cover plate accepts either a two-way valve for controlling single-acting cylinders or a four-way valve for controlling double-acting cylinders. Reservoir capacity is 2 gal.

Owatonna Tool Co., 544 Cedar St., Owatonna, Minn. **Circle 430**

Digital Process Controller Adds, Subtracts

When preset numbers are reached, this add-subtract digital process controller automatically actuates machine control functions. The controller adds or subtracts when pulses from a trans-

ducer or sensing device are applied on two lines to the controller for virtually any up-and-down counting or measuring operation. When successive preset numbers are reached, control functions are performed. Preset numbers can be set up by panel knobs or by punched tape, magnetic tape or punched cards. Tyypical applications of the controller include cutting-to-length, positioning, balancing, drilling and coil winding.

Louis Allis Co., Dept. P, Milwaukee 1, Wis. **Circle 431**

Heat-Treating Unit Does Many Jobs

Practically every heat-treating operation can be done with the Model TP-D triple purpose furnace. It can be used for hardening, forging, welding, annealing, normalizing, pack carburizing and nonferrous metal melting. The three-furnace unit consists of a pot furnace, an oven and a forge. It is available in five sizes for gas-fired heating.

Sunbeam Equipment Corp., 168 Mercer St., Meadville, Pa. **Circle 432**

Optical Attachment for Visual Grinding

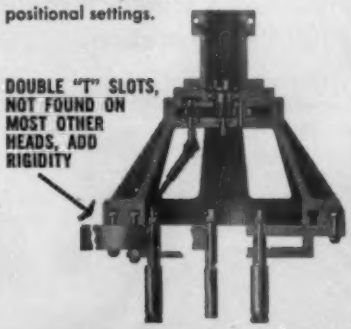
Consisting of a microscopic eyepiece through which are seen the wheel and workpiece, magnified 25, 50 or 100 times and superimposed over the desired form on a reticle, this instrument permits visual control for grinding on surface and cylindrical grinders. It provides continuous optical inspection through all stages of form grinding. An independent optical unit that can be

JARVIS UNIVERSAL JOINT MULTIPLE SPINDLE HEADS

* For example, you can add to the basic head one or more of 20 optional accessories (such as Spindle Assemblies, Spindle Cluster Plate, Base Plate, Guide Rods, etc.) to meet the requirements of a particular job. With Jarvis Heads you have a greater selection of parts and accessories. A buy-only-what-you-need, custom-built head without having to pay the high cost of regular custom designed heads. Universal joints are of an advanced structural design which feature: low deflection rate; superior fatigue resistance; greater overload capacity and longer life. Joints have a snap-on feature and can be slipped off the spindle without use of tools.

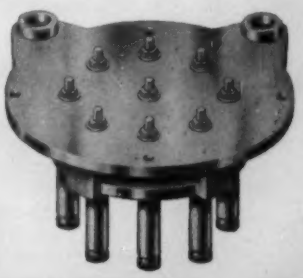
EXCLUSIVE JARVIS FEATURES

Cut-away view (below) reveals high strength, light weight aluminum alloy castings, heavily ribbed for durability; gears and spindle drivers run in ball bearings, have more than thrust load capacities; idler gears mounted on heavy duty needle bearings running on specially heat treated steel studs; adjustable outrigger arms locked in position with threaded studs located in double "T" slots for positive positional settings.



NO NEED TO INVENTORY SEVERAL FIXED HEADS

Head converts easily to a fixed head by adding a Jarvis Spindle Cluster Plate (shown below) which can be jig bored, by you or by us, to locate spindles to suit hole spacing required. Cluster Plates will aid in reducing setup time and will assure correct setup each time.



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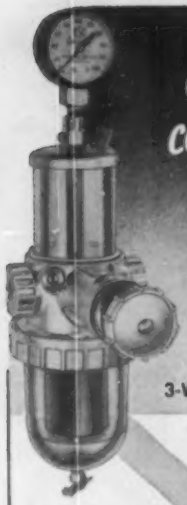

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PSC

3-WAY AIR CONTROL

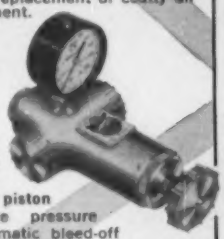
REGULATOR
FILTER
LUBRICATOR

This compact package unit removes dirt, grit scale and moisture—prevents rusting and scoring—balances air surges—serves as shut-off valve.

Saves many dollars and valuable time by preventing unnecessary maintenance—down-time—and replacement of costly air tools and equipment.

REGULATOR

Accurate
Dependable
Positive Seating



Large orifice and piston maintains accurate pressure adjustment. Automatic bleed-off saves valuable set-up time. Balances pressure surges. Proper pressure assures peak performance.

FILTER

Dual Filtering
Cyclonic Action

Fine filtering removes dirt scale and condensate. Prevents damage due to dirty air. Permits air tools to operate at top efficiency. Less down-time, more production-time.

LUBRICATOR

Automatic Won't Flood

Automatic foglike oil mist protects and lengthens service life of air tools and equipment. Prevents costly repairs and replacement of air tools due to scoring and rusting. Assures long trouble-free service.

REGULATOR-FILTER

Accurately regulated, clean, moisture-free air assures a smoother, more efficient tool operation. Maintain peak production. Cut production costs.

Ask for Bulletin 80, listing and describing our complete line of Air Controls.

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New York Providence Montreal Toronto Canada

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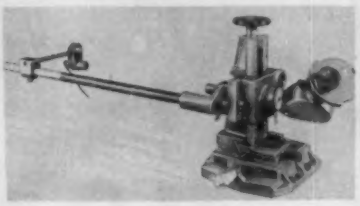
TOOLS of today



attached to grinders, the Profiloscope controls irregular and intricate forms that previously had to be ground on special machines.

Parker-Hartford Corp., Hartford, Conn. **Circle 433**

Units Convert Machines to High-Speed Grinders

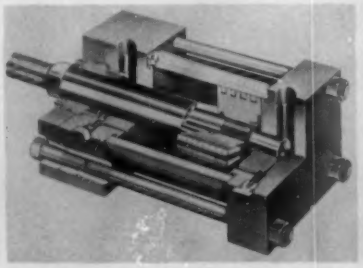
Holes from 0.020 to 0.250 inch in diameter can be ground with the Vulcanaire grinding units. The 300 Series, with a speed range of 215,000 to 300,000 rpm, is used on holes 0.020 to 0.090 inches in diameter. The 5000 Series, for

holes measuring 0.090 to 0.250 inches in diameter, has a speed range of 100,000 to 175,000 rpm. These units, which are interchangeable with the 10,000 and 20,000 Series units for grinding 0.250 to 8-inch holes, have an accuracy to tenths.

Vulcan Tool Co., 730 Lorain Ave., Dayton 10, Ohio. **Circle 434**

Hydraulic Cylinder Handles 3500-Psi Operation

Features of the HH Series interchangeable hydraulic cylinders include tie rod construction and four different types of piston packing for various applications. They are available with bores from 1⅛ to 14 inches and with 18 mountings for operation up to 3500 psi.

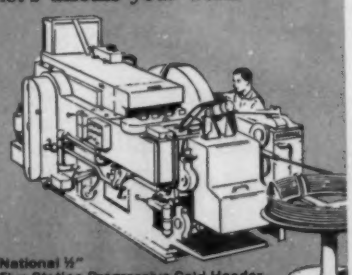


still more parts from wire!

These important parts are cold-formed from coiled wire, start to finish in compact, efficient National Cold Headers.

These parts are formed practically scrapless. All achieve remarkable savings over past methods.

If you make odd-shaped parts, may we help you evaluate them for cold-forming from wire? Better yet, come to Tiffin, witness our demonstrations and let's discuss your work.



National ½"
Five-Station Progressive Cold Header

NATIONAL MACHINERY CO.
TIFFIN, OHIO, U.S.A.
HARTFORD DETROIT CHICAGO

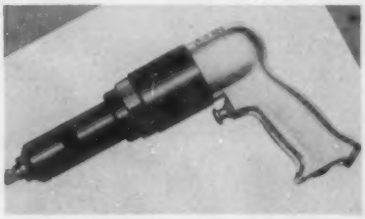
Use Reader Service Card, CIRCLE 86

Piston rods are 110,000 psi high tensile steel and rod wipers are of Teflon. Rod packing is the self-adjusting, multilip type. Their tapered cushion eliminates cushion adjusting screws, provides positive gradual deceleration and eliminates shock.

Sheffer Corp., 326 W. Wyoming Ave., Cincinnati 15, Ohio. **Circle 435**

Nutrunner, Screwdriver Clutch Controls Torque

Two models with a torque control clutch have been added to the 41F Series air-powered, pistol grip screwdrivers and nutrunners. This clutch is adjustable for torque from 5 to 100 in-lb. Clutch jaws automatically disengage when a preset torque is reached and set themselves for the next fastener as soon as the tool is released

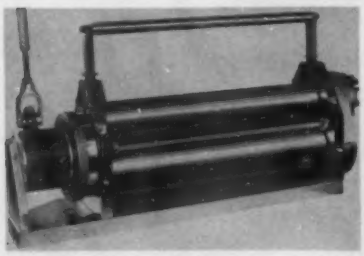


from the work. The nutrunner model has a $\frac{3}{8}$-inch square drive front end. As a screwdriver, the tool has a $\frac{1}{4}$-inch female hex spindle.

Buckeye Tools Corp., 5003 Springboro Pike, Dayton 1, Ohio. **Circle 436**

Roll Feed Has Long Stroke

Equipped with a set of fully enclosed gears, the Series 9 PRF precision roll feed has an adjustable stroke of 0 to 9 inches. Roller lengths are suitable for 15-inch stock widths. The roll feed is



reversible and has a roller cam clutch. The bottom feed roller is $3\frac{7}{8}$ inches in diam and is completely hollow to reduce inertial lag and momentum, thus permitting operating speeds up to 200 spm. Heavy roll pressure is maintained by spring loading, giving positive, nonslip feeding. The unit can be operated with or without a bell crank.

Benchmaster Mfg. Co., 1835 W. Rosecrans Ave., Gardena, Calif. **Circle 437**

Dial Indicator Holder Speeds Center Finding

This Ever-True dial indicator holder simplifies center finding. One adjustment of the holder's eccentric shank aligns the dial indicator to the spindle centerline. This setting can be locked and permanently retained to compensate for the characteristic offset of the ball point from center. To adjust the dial indicator to sweep any diameter, a knurled knob is turned in a positive-sensitive adjustment that may be locked rigidly at the desired position. The holder will indicate from $\frac{1}{16}$ to 12 inches in diameter.

Edgcomb Engineering and Engraving Co., 1105 N. Hollywood Way, Burbank, Calif. **Circle 438**

Electrolytic Grinders Machine Hard Materials

Additions to a line of oscillating electrolytic grinders are Models EGD-12 and 14. With duplex infeed tables, these models are especially suited for steel and superalloy parts as well as carbide tools. Grinding with these machines is

THE OHIO KNIFE CO. CAN MAKE

BETTER — our time proven process of bonding special analysis tool steel to tough machineable steel, then hardening the tool steel (65-66 Rockwell C) along entire length, enables us to give you hardened surfaces anywhere you want them.

FASTER — we make hundreds of these special shapes for every conceivable application—our new production methods are geared to meet fast delivery requirements.

LOWER-IN-PRICE — no one is as completely set-up — design, engineering, heat treating and production—to deliver these special ways to you at a price far below what it would cost you to make them yourself.

IMPORTANT — we carry in hardened stock 12 standard way shapes in 88 sizes, with delivery from stock to 5 weeks.

For FREE Bulletin-A, describing O-KNI-CO hardened ways, wear plates, etc., write Dept. 122-U

THE OHIO KNIFE CO.
CINCINNATI 23, OHIO
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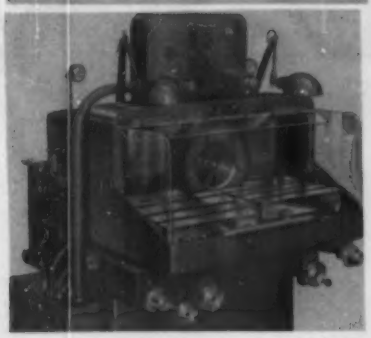


burrless and workpieces are free from metallurgical damage. The grinders accommodate 12 and 14-inch-diam wheels.

Hammond Machinery Builders, Inc., 1661 Douglas Ave., Kalamazoo, Mich. **Circle 439**

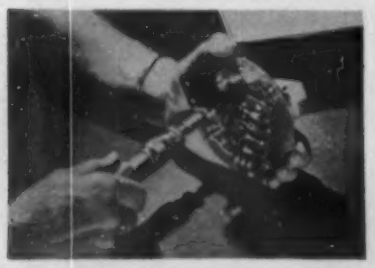
Automatic Machining System Is Numerically Controlled

Included in the Position Master numerical tape control package is a tape punch, a Bridgeport vertical miller and a control console. The tape punch is a transistorized measuring machine that operates electromechanically to punch tape for desired operations. The miller is completely fitted with a digital transducer assembly, position indicating controls and motor drives. The fully transistorized control console contains a digital converter, tape reader and motor controls. Accuracy of the system—which can be operated manually, semi-automatically or completely automatically—is ±0.001 inch.

Ultra-Sonic Precision Co., Inc., Mount Vernon, N. Y. **Circle 440**

Torque Screwdriver Has Inch-Ounce Range

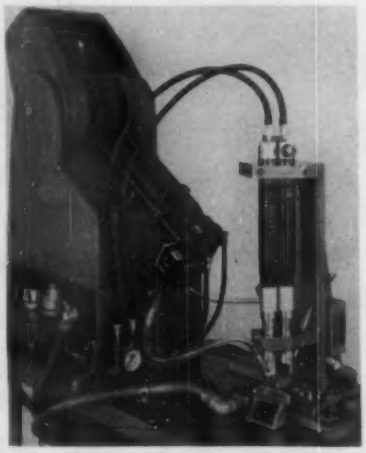
Made in both fixed setting and adjustable models, this torque screwdriver is suitable for delicate electronic assembly work. The adjustable TS-100 model has a torque range from 4 to 100 inch ounces. Adjustment is made by setting a micrometer type dial. The tool contains a ¼-inch square male drive, is 6½ inches long and weighs 8 oz. The fixed setting model, TS-SN1 has a torque range from 1 to 100 ounce inches, is 5 inches long and weighs 6½ oz.



Hunter Tools, 9851 Albertus Ave., Santa Fe Springs, Calif. **Circle 441**

Screwdriving Unit Has Automatic Operation

Incorporated in the dual spindle Tru-Tork automatic screwdriving machine are two air-fed screwdrivers with Tru-Tork nose pieces and a double track oscillating hopper with two metering devices. In operation, a shuttle type fixture is used to push the part into position where it is held firmly by a nylon pressure pad. When the part is centered under the driving head, a limit switch is contacted which initiates the drivers.



Screws are simultaneously metered and completed parts are automatically unloaded into the chute. The machine uses normal shop air pressure to operate driving heads and a 40-lb pressure to operate the metering device.

Clyde Engrg. and Mfg. Co., 937 East 10 Mile, Madison Heights, Mich. **Circle 442**

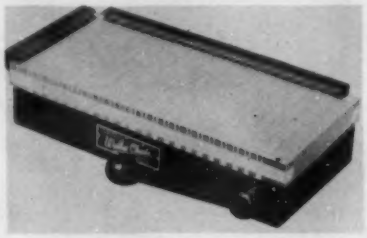
Solid Carbide Mill Cuts Hard Metals

Because of its tendency to counterbalance the right hand turning action of the spindle, the Master Mill solid carbide end mill results in a neutrally stressed tool. Available in sizes up to one inch in diameter and in ball end style, if desired, it is intended for either interrupted or uninterrupted machining of refractory metals R_C 50 or harder. The mill has a multiple number of teeth which retain edge sharpness longer than conventional 2 or 4 flute mills.

Metal Removal Co., 1801 W. Columbia Ave., Chicago 26, Ill. **Circle 443**

Chuck Solves Heat Generation Problems

Problems caused by heat generation when holding large ferrous workpieces are solved by the Electroperm chuck. The chuck combines permanent magnets with electric coils to eliminate



distortion due to thermal expansion while maintaining dimensional stability of the chuck. Electric current turns the chuck on but, once the chuck is electrically energized, permanent mag-

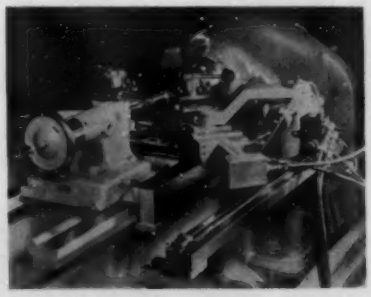
USE READER SERVICE CARD ON PAGE 123 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

nets take over to provide the magnetic holding power. The permanent magnetic holding also eliminates danger caused by power failures. The chuck is available in sizes from 12 x 24 inches to 42 x 96 inches.

O. S. Walker Co., Worcester, Mass. **Circle 444**

Toolroom Lathe Gains Tracer Attachment

Shown below is a close-up view of the tracer attachment which, along with infinitely variable power feed, is a special feature of the Model 1020M manufacturing lathe. The machine



takes a ¼-inch cut in cold-rolled steel or turns to accuracies at 0.0004 inch in 12 inches. With a 12½-inch swing, the spindle takes collets up to 1⅛-inch capacity. The machine is available with either 20 or 30-inch centers. Power longitudinal feeds are from zero to 16 ipm and power crossfeeds from zero to 8 ipm.

Rivett Lathe & Grinder, Inc., Brighton 35, Boston, Mass. **Circle 445**

BIG SAVINGS IN
LARGE CUTS

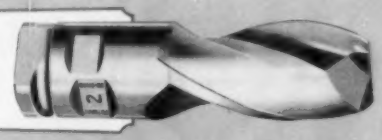
CUT YOUR COSTS OVER 25% ON END MILLS 1½" DIAMETER AND LARGER WITH

The Putnam Postiv-Lok design for large end mills eliminates the need for and expense of long tapered shanks. Instead, the Postiv-Lok concept of end mill tooling puts the heavy shank on a holder that quickly pays for itself through savings realized in the purchase of Postiv-Lok end mills.

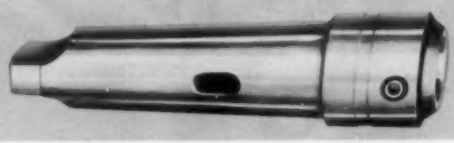
Also, the use of Postiv-Lok end mills and holders eliminates the costly breakage that is possible with welded shank end mills. Postiv-Lok end mills are milled from solid steel—there are no welds that might break and separate the shank from the fluted portion. Thus, Postiv-Lok eliminates a cause of costly shut-downs and replacements.

Another cost saving is realized with Postiv-Lok during tooling change-over. Being much lighter, Postiv-Lok end mills are easier to handle than large tapered shank end mills—easier to insert and remove. And, when the next operation requires a different style or size of end mill, or even drilling and reaming, Postiv-Lok adapters permit quick change-over from one tool to another without changing the holder in the spindle.

Save this much on End Mills with....

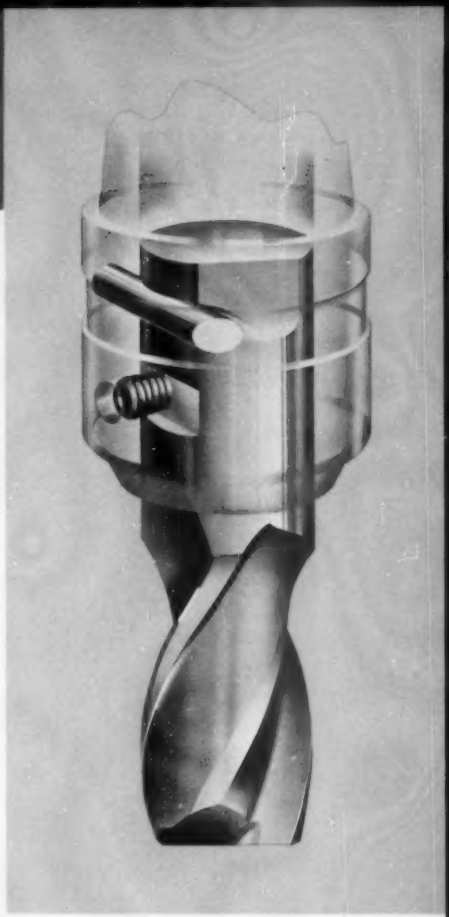


PUTNAM POSTIV-LOK **HOLDER**



PUTNAM PRECISION TOOLS

Putnam Postiv-Lok



Postiv-Lok is a proven locking mechanism for large end mills. It has saved time and costs for countless users throughout the country. Try it on your most rugged milling application. Postiv-Lok is available from stock on end mills ranging from 1½″ to 3″ in diameter. Also, it can be furnished in special sizes and designs to your specifications.

Here is how Postiv-Lok assures positive locking of end mills in the holder (see phantom drawing for lock construction). Simply insert the end mill in the holder so the top flat is positioned to pass the locking pin; give the end mill a quarter turn to the right and it is securely locked in the holder. Tightening of holder set screw prevents end mill backlash. The end mill cannot vibrate loose or pull out of the holder. In fact, the locking action is aided by the torque of the end mill in operation.

When put to work on big jobs, the fast, free-cutting action of Postiv-Lok end mills really save time and costs. Also, their exceptional durability assures long life even when operated at high speeds and heavy feeds. Try them on your toughest jobs—they will get them done faster and at lower cost.

CUT FASTER – LAST LONGER

Over 1800 Standard Types & Sizes of Putnam End Mills

Now you can order standard end mills ranging in diameter from 1/32" to 6" and get off-the-shelf delivery. In the Putnam line of over 1800 standard types and sizes, are many end mills that are considered as "specials" by other manufacturers.

Regardless of your requirements, there probably is a Putnam standard end mill that will exactly meet your needs. Thus, you can obtain quicker delivery, plus all the superior Putnam cutting qualities, and at lower costs than "specials".

You will save time, money and space by using the services of your local Putnam Distributor

- He has large stocks that are immediately available.
- He is dependable and handles quality products.
- A source for new techniques and new products.
- Being one source for many products, he simplifies your purchasing.
- He affords personalized attention to your needs.
- Using his services assures savings in your stockroom space requirements.
- His stocking of products means you have less money tied up in inventory.

DISTRIBUTORS
IN CITIES
COAST TO COAST

Men at Work

Executive changes have been announced by Chromium Corporation of America, New York, N. Y. WILLIAM J. ZUBRISKY (pictured), formerly executive vice president, has been elected president and chief executive officer, succeeding DONALD H. BISSELL (pictured), who has been named chairman of the board. Zubrisky and Bissell have been associated with Chromium Corp. for more than 35 years.

William J. Zubrisky

Donald H. Bissell

The election of VERNON MARSH (pictured) to vice president of the American Pulley Co., Philadelphia, Pa., a division of Van Norman Industries, Inc., has been announced. Marsh had been factory manager. He joined American Pulley in 1959 with more than 20 years experience in production and manufacturing methods.

LOUIS B. ZAMBON (pictured) has been appointed vice president of engineering by Pratt & Whitney Co., Inc., West Hartford, Conn. After impressive service with the U. S. Air Force, Zambon, from 1955 to date, was responsible for the engineering, development and marketing programs of advanced turbo-jet engines for a leading manufacturer in the field.

JOHN J. WALLACE has been elected president and general manager of Prab Conveyors, Inc., a Detroit, Mich., manufacturer. Wallace was previously associated with Hapman Conveyors, Kalamazoo, Mich. He was active in aircraft and machinery manufacturing prior to joining Hapman in 1957.

M. B. DONAHUE has been named vice president in charge of sales for Edlund Engineered Products, Inc. He was formerly president of Aviation Industries, Elizabeth, N. J., and assistant to the president of Air Associates, Teterboro, N. J.

Lionel Corp. has announced the election by the board of directors of Lionel Electronic Laboratories of DR. WALTER K. VOLKERS (pictured) as president, director and chief executive of Lionel Electronic Laboratories, formerly Anton Electronic Laboratories, located in Brooklyn, N. Y. Prior to joining Lionel, Dr. Volkers served as vice president of research and development for the Massa Div. of Cohu Electronics, Inc. NICHOLAS ANTON, who formerly occupied these positions, has resigned, but will remain associated with the laboratories in an advisory capacity.

Chicago Pneumatic Tool Co., New York, N. Y., has announced the election of GUY J. COFFEY as chairman of the board and chief executive officer. Coffey succeeds H. ARNOLD JACKSON who will continue as a director and chairman of the executive committee. NORMAN READMAN has been elected president to succeed Coffey. Readman, formerly managing director of overseas operations, joined the company in 1943. THOMAS F. NOONAN, elected vice president and comptroller, has been with Chicago Pneumatic since 1938. CARRA L. LANE is a new vice president and manager of plant operations.

Rheinische Stahlwerke (Rheinstahl), Essen, Germany, has appointed HARRY L. SHOWALTER (pictured) as director of North American operations. Showalter is an American industrial consultant and owner of Girard Associates located in Chambersburg, Pa. In appointing Showalter, Rheinstahl emphasized its intention to foster and expand its already extensive cooperation with American industry all over the world.

JAMES A. MILLER has been appointed vice president in charge of engineering research and development of Motec Industries, Inc., Hopkins, Minn. Miller began his engineering career in 1942, and joined Motec Industries in 1959.

Rockwell-Standard Corp. has announced that COL. WILLARD F. ROCKWELL, chairman of the board of both Rockwell-Standard Corp. and Rockwell Mfg. Co.,

Vernon Marsh

Louis B. Zambon

Harry L. Showalter

Walter K. Volkers

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NOPAK OFFERS YOU COMPLETE AIR CIRCUITRY

another Plus Value by NOPAK

The addition of Nopaxam palm button, cam, lever and air operated valves "closes the Nopak circuit." Precise control — mechanically or electrically signaled — can now be *completely* Nopak. Singularly or in combination, Nopaxam, Nopak "V" valves and Nopak-matic valves will meet your most complex circuit requirements.

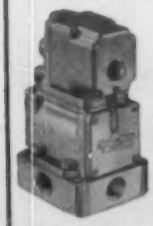
Nopak "V," 4-Way, Pilot Operated Slide Valves

For direct or remote control. Either single or double air pilot or solenoid actuated. Simple, proven design, durable construction insure trouble free operation. See Catalog 102-A.

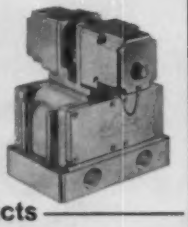
Nopaxam Precision Spool Valves

For air or hydraulic service to 150 psi. Pilot or mechanically operated, these valves are small, compact, easily mounted, have extremely short throw and high flow rates. See Catalog N.

NOPAK-MATIC Poppet-Type, Pilot Operated Valves



Fast acting, high volume air valves from ¼" to 1¼" with master (air piloted), single or double solenoid. Side or bottom ported subplates or manifolds. Removing cover plates affords easy access to piston poppets housed within removable, interchangeable cartridges. 100% J.I.C. See Catalog 105.



Other NOPAK "CVA*" Products

NOPAK Class 1 Cylinders

Brass Tubing and Tie-Rod Construction. For pressures to 250 psi. Choice of adjustable cushion, self-regulating or non-cushion heads. Diameters from 1½" to 16". 6 Standard Mountings. See Catalog 101-A.

NOPAK Class 6 Bore-Rated Cylinders

Compact steel plate, square head with tie-rod and honed steel tubing construction. For air pressures to 250 psi. hydraulic pressures to 1500 psi. See Catalog 106.

NOPAK Class 7, Square Barrel Cylinders

Made with pressure-cast and extruded aluminum. Mounting holes can be drilled or tapped directly into cylinder tubing. ¾" to 3" bores pressure rated for 200 psi. air or 1000 psi. oil. 7 universal mountings. See Catalog 107.

*CVA Cylinders, Valves, Accessories
NOPAK offers a complete line of Matched Fluid Power Components.

NOPAK
VALVES & CYLINDERS

NOPAK DIVISION
Galland-Henning Mfg. Co.
2750 S. 31st St., Milwaukee 46, Wis.

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Men at Work

has been elected chairman of the Council of Trustees, the governing body of the Association of the United States Army. This honor was especially significant in that Col. Rockwell is the only individual ever to hold this office for more than one term.

PHILLIP S. FOGG, board chairman of Consolidated Electrodynamics Corp and vice chairman of Bell & Howell Co., has been elected chairman of the board of Consolidated Systems Corp., Monrovia, Calif., an associate company of Allis-Chalmers, Bell & Howell, and CEC. Fogg succeeds WILLIAM E. ROBERTS, formerly executive vice president of Bell & Howell.

The appointment of WILLIAM R. DONNELLY as president of Chrysler Corp.'s Amplex Div., has been announced. Donnelly succeeds WILLIAM P. BALTHROP who recently was appointed president of Airtemp Div. Prior to his new appointment, Donnelly was treasurer of Chrysler International, S. A., with headquarters in Geneva, Switzerland.

The board of directors of Ford Motor Co. has elected EUGENE BORDINAT, JR., as a vice president. Bordinat, chief stylist of the Lincoln-Mercury studio since 1958, will become director of styling, succeeding GEORGE W. WALKER. Walker, who retires this month, will continue to serve as styling advisor.

Hitchiner Mfg. Co., Inc., has announced the election of HOWARD W. JOHNSON to the board of directors of the firm. Johnson is dean of the school of industrial management at Massachusetts Institute of Technology, Cambridge, Mass., and is a director of and consultant to a number of other industrial firms.

W. B. BURKETT, chief engineer for the Los Angeles division of McCulloch Corp., has been promoted to vice president and general manager. Burkett will be responsible for the engineering, manufacturing, sales and quality control functions of the Los Angeles division.

Merkle-Korff Gear Co., of Chicago, Ill., has announced the election of WALTER STRAND, formerly vice president and general manager, as president; and JOHN SIMMS, formerly assistant vice president, as vice president. Strand joined the firm in 1937 as assistant to the president. Simms has been with Merkle-Korff for eleven years and has successively been production manager, plant manager and sales manager.

WALTER H. IRWIN has been appointed president of Metal Atomizing and

Processing Corp., manufacturers of ferrous and nonferrous metal powders. Irwin was formerly vice president of Canada Metal Co. Ltd., a subsidiary of National Lead Co.

Edward M. Haines

J. Roy Barefoot

EDWARD M. HAINES (pictured) has been elected to the new post of vice president of engineering for Stanley Works, New Britain, Conn. Haines will be responsible for the direction of Stanley Works' manufacturing engineering and product development activities. Before joining Stanley, Haines was vice president and assistant to the president with York Div. of Borg Warner Corp.

The board of directors of McKay Machine Co., Youngstown, Ohio, has appointed J. ROY BAREFOOT (pictured) to be the firm's executive vice president. RALPH N. LEITZELL will fill the post of vice president and treasurer. D. M. DAVIS, formerly vice president and treasurer, was appointed vice president in charge of special projects. Barefoot had been president of Federal Machine and Welder Corp. until that firm's merger with McKay.

The board of directors of Rohr Aircraft Corp., Chula Vista, Calif., has elected J. S. RICE as a vice president of the corporation. Rice has been manager of the company's manufacturing plant at Riverside, Calif., and will continue in that capacity. Prior to joining Rohr, he was manager of military sales for Garrett Corp. in Los Angeles.

STANDARD'S
Center-Cutting
END MILLS . . .

Built TOUGH ENOUGH for tough metals . . .

. . . whether it's plunge or traverse cutting . . . profiling . . . cavity milling . . . die sinking or conventional slot milling, STANDARD'S END MILLS perform longer, more efficiently, with a finer work finish on difficult machining operations.

. . . . Call the STANDARD Distributor in your area, he will show you a variety of TWO-, FOUR- and SIX-FLUTE, Double or Single End Mills . . .

MORE metal removed at LESS COST • Standardize • with STANDARD • Quality!

DEPEND upon STANDARD'S Authorized Distributors . . .
For Twist Drills, Reamers, Taps, Counterbores, End Mills, Milling Cutters, Hobs, Gages, Dies, Carbides (solid or tipped) . . . and for Engineering or Technical Information.

STANDARD TOOL CO.
3950 CHESTER AVENUE · CLEVELAND 14, OHIO
BRANCH WAREHOUSES IN: NEW YORK · DETROIT · CHICAGO · DALLAS · LOS ANGELES · SAN FRANCISCO

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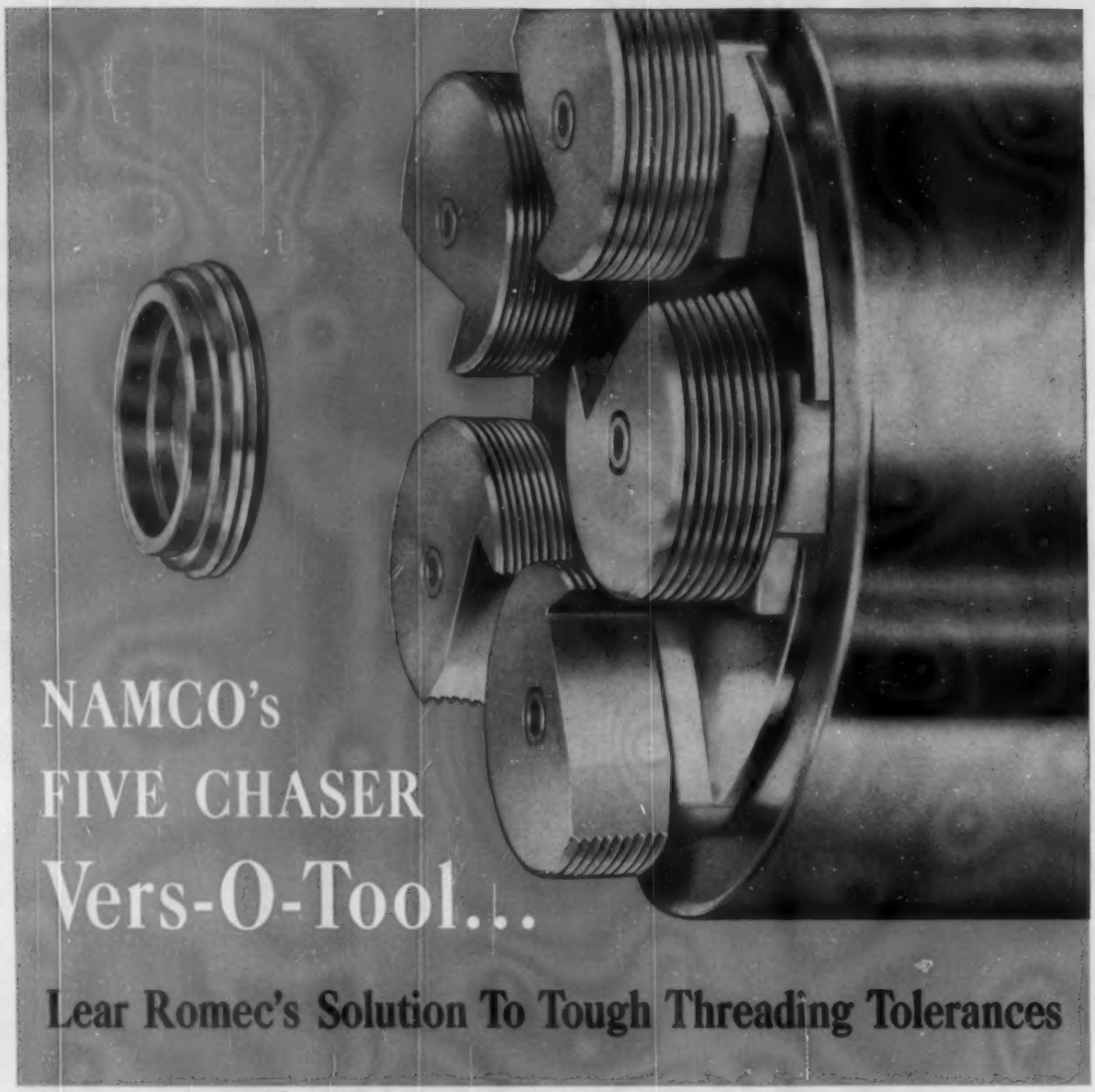

NAMCO's FIVE CHASER Vers-O-Tool...

Lear Romec's Solution To Tough Threading Tolerances

Charles Van Auken, Assistant Chief Production Engineer at Lear Romec Division of Lear, Inc., Elyria, Ohio tells us: "Threading specs for this lock-nut for a jet engine vane pump are tough . . . 1⅛—12N —3A, +.0000 and —.0045 on pitch diameter, 100 RMS on surface finish. Naturally, we use a NAMCO 5-Chaser Vers-O-Tool. It consistently surpasses the specs and sets up in a *fraction* of the time required for a 4-chaser tool. On threading jobs like this, the 5-Chaser Vers-O-Tool is our margin of profit!" Anyone who has ever used a NAMCO 5-Chaser Vers-O-Tool will agree. There just isn't anything that threads better. And, there are good reasons . . . all outlined in our new Bulletin DV-1 "Five Circular Chaser Threading". At your request, we'll be happy to send you a copy.

National Acme

THE NATIONAL ACME COMPANY
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technical shorts

Tungsten Die Steel—A new tungsten tool and die steel developed by The Carpenter Steel Co., Reading, Pa., offers up to four times the service life of high-carbon, high-chrome steels. Known as Carpenter Hi Wear 64, this steel is a deep-hardening grade that can be heat treated at temperatures lower than those required for other steels designed for high-wear applications. Hi Wear 64 hardens through to the center in sizes up to 6 inches in cross section when oil quenched from 1450 F. Intricate shapes up to 2 inches in diameter can be hardened from 1550 F. Relatively low hardening temperature of this steel offers maximum protection against the danger of decarburization, distortion and surface damage while saving on the expense of hardening at high temperatures.

Grinding Wheel Hardness—Development of a new method of determining the hardness of grinding wheels has been reported by the University of Michigan. The test, which can be run on a wheel in just a few seconds, involves crushing small amounts of abrasive from the surface of the grinding wheel by contact with a hard steel wheel. The steel wheel—small and conical in shape—is mounted at 45 deg to the surface of the grinding wheel, on a spindle attached to a force-measuring dynamometer. In testing, the grinding wheel is rotated and the small wheel passes over its surface. Reaction forces measured by the steel wheel provide a sensitive indication of significant variations in wheel hardness.

Protecting Painted Surfaces—A new acid etch that provides increased paint protection on galvanized surfaces has been developed by the Martin-Senour Co., Chicago. Called Galva Etch, it cleans and etches galvanized, galvanealed, zinc-treated and cadmium-plated surfaces preparatory to painting. Providing a good anchor for paint while improving the quality and durability of the paint coat, the acid etch prevents the flaking and peeling which commonly occurs with zinc-treated metals.

Machining Malleable Iron—New data on the machining characteristics of malleable iron castings indicate 1. that the ferritic grades can be worked easier and faster than many of the free-cutting steels and 2. that hardness values are not adequate as indicators of malleable's machinability. Comparisons of three grades of pearlitic malleable iron with nodular and grey irons of similar hardness show that one grade of pearlitic malleable was greatly superior, a second about equal in machining characteristics, and a third inferior to the other two metals.

This phase of the research fortified conclusions drawn from previous studies which indicated that microstructure, especially in the case of malleable irons, had more to do with machinability than any other characteristic. Although malleable is a ductile engineering material, carbon is contained in its matrix. This contributes to the lubricating effect between tool and workpiece, and to the formation of discontinuous chips.

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ENGINEERING BOOKSHELF

MODERN PRODUCTION MANAGEMENT—*By Elwood S. Buffa. Published by John Wiley & Sons, Inc., 440 Park Ave., S., New York 16, N. Y. Price $10.25. 636 pages.*

Beginning with a brief review of the history of management in production, this book progresses to management's role in the Space Age. Principal subjects covered include analytical methods used by management, design of production systems, and their operation and control. Each of these is subdivided into the various topics of importance to engineers who are considering management as a career.

Readers, either in or out of management, will find the discussions of digital computers and automation highly useful. The approach taken to these topics is fundamental and should provide an excellent base from which to study the more advanced or specialized aspects of automation.

HOW TO BECOME A PROFESSIONAL ENGINEER—*By John Constance. Published by McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y. Price $5.50. 272 pages.*

Of interest to engineering students and seasoned engineers alike, this book states the purpose of professional registration and summarizes laws and regulations regarding its attainment. Men considering application for registration will find the chapters on the registration examination particularly useful. These discuss the examination in detail, showing the subjects covered, the amount of time spent on each, and the values assigned to each in the different States.

PLASTICS TOOLING, SECOND EDITION—*By Malcolm W. Riley. Published by Reinhold Publishing Corp., 430 Park Ave., New York, N. Y. Price $7.50. 216 pages.*

Many of the materials and techniques described in this book are relatively new and were not discussed in the first edition. These include metal-fiber reinforced plastics and gas or electroless nickel-plated surfaces for plastic tools. Data and use of each technique are treated clearly and concisely, and enough theory of resin chemistry is discussed to enable engineers to work intelligently with modern plastics.

REINFORCED PLASTICS FOR ROCKETS AND AIRCRAFT—*Published by American Society for Testing Materials. Price $5.50. 134 pages.*

Consisting of papers presented at the Third Pacific Area National Meeting of ASTM, this book examines the role of plastics in Space Age applications. Topics discussed include reinforced plastics, high-temperature structural applications, evaluation of plastics, principles and capabilities of ablation, re-entry conditions and arc-jet measurements.

AUTOMOTIVE WELDING DESIGN—*Published by American Welding Society, Inc. Price $2.50. 48 pages.*

Recommended designs for welded components are discussed in this book. Also discussed are standards, symbols and types of welding to apply to certain applications. Although this book has been compiled for designers in automobile factories, its usefulness will extend to all designers concerned with welding.

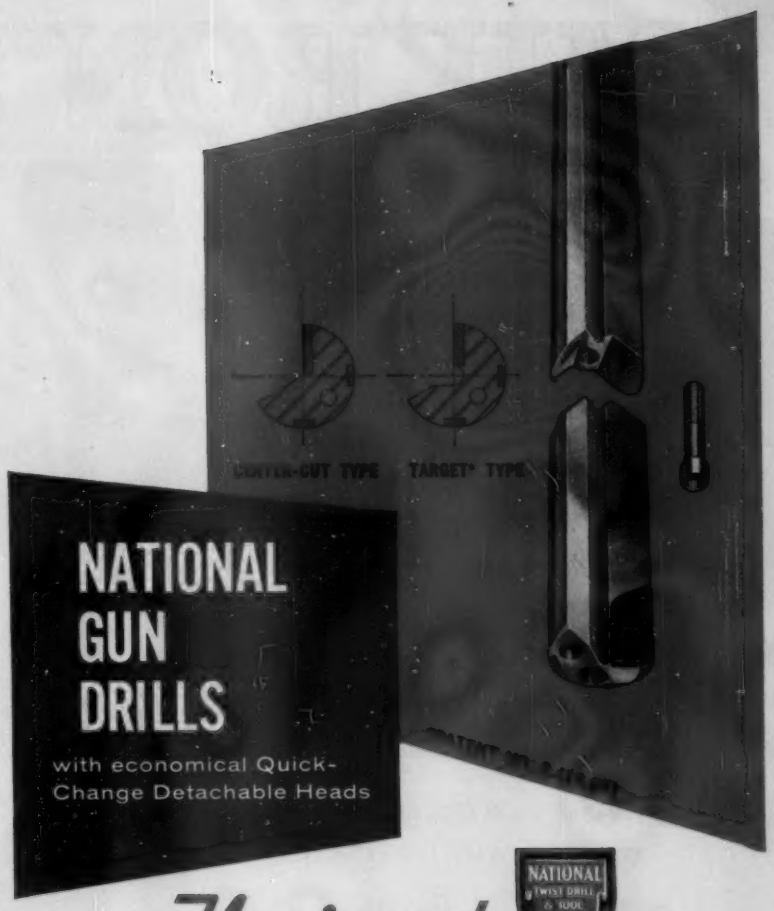
HIGH-STRENGTH STEELS FOR THE MISSILE INDUSTRY—*Edited by H. T. Sumsion. Published by the American Society for Metals, Novelty, Ohio. Price $12. 276 pages.*

Comprised of papers presented at a symposium on the subject, this book covers the following papers: Materials and Fabrication Problems in Pressure Vessels; Stress Corrosion of Aircraft and Missile Steels; Fracture Theory in Pressure Vessels; Pressure Vessel Reliability; NASA's Program—High-Strength Sheet Alloys; New Ultra-High-Strength Steel for High Performance Rocket Motor Cases; Fabrication Techniques for Rocker Motors; Shear Spinning in Fabrication of Solid-Propellant Rocket Cases; Large Solid-Propellant Rocket Case Fabrication by Deep Drawing; and Future Applications of High-Strength Steels. Prepared by experts in these fields, the papers present an excellent picture of the current applications of steel to missile development.

NUCLEAR ENGINEERING—*By Gilbert Cahen and Pierre Treille. Published by Allyn and Bacon, Inc., 150 Tremont St., Boston 11, Mass. Price $8.50. 394 pages.*

Translated from the French and brought up to date by Gilbert B. Melese, this book reviews the principles of nuclear physics in its early chapters and then moves into the theory of nuclear reactors. Types of reactors currently used in Britain, France and the Soviet Union are discussed.

Teaching aids included in *Nuclear Engineering* are conversion and nuclear data tables, charts, graphs and problems related to basic principles. Excellent documentation and bibliographies are provided for the benefit of students interested in further study.



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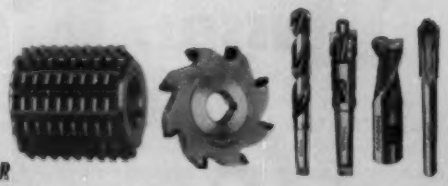

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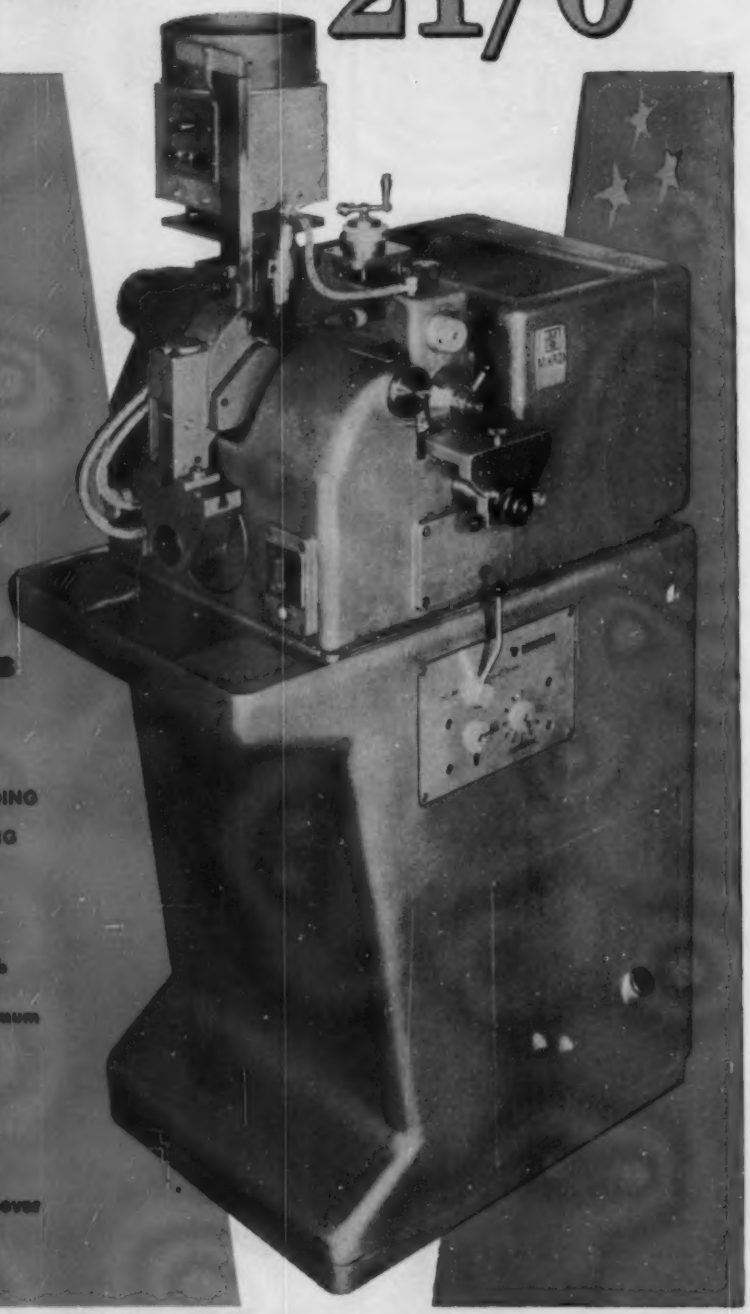

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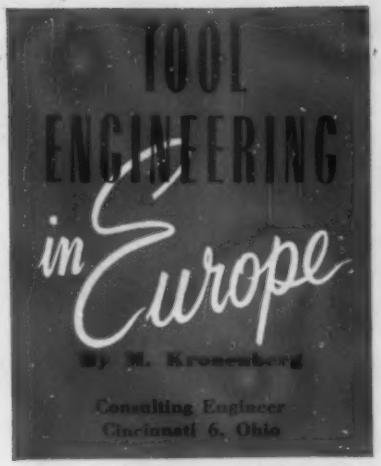

Machinability Testing

Testing of the machinability of metals by applying a constant feed pressure, usually with a weight, has been practiced for many years. H. Becker describes an improved technique in an article: "Kurzpruefung der Zerspanbarkeit von Automatenstaehlen nach dem Gewichtsvorschub Verfahren," which appears in *Stahl und Eisen*, Vol. 81, No. 1, 1961, p. 46-50.

In Becker's method, the lathe carriage is moved by a weight that replaces the feed rod or leadscrew. The resulting feed rate is used as a measure of machinability. Becker found it necessary to use special roller bearings underneath the carriage in order to avoid tilting of the carriage. Also, he installed automatic devices for measuring the distances traveled and the rpm of the machine. Covers were used to keep the guideways free of chips or other foreign material that could change the coefficient of friction.

The weight that pulls the carriage must be adapted somewhat to the expected machinability. Thread cutting would occur in the case of a weight that is too heavy or, in the case of a weight that is too light, the tool would not cut—it would only scratch the workpiece. Becker finds, however, that machinability testing by the constant pressure method is advantageous for comparing several steels of the same group, carbon steels for example, since the method is sensitive and permits small differences in machinability to be readily determined.

Dynamic Chucking Force

Due to increased cutting speeds, the centrifugal forces acting on hand-operated chucks have increased about a hundredfold during the past three decades. The higher centrifugal forces decrease the gripping force that holds the workpiece. Since the trend is toward even higher cutting speeds, it is important to investigate the decrease in gripping force with increasing speeds.

G. Pahlitzsch and H. J. Warnecke have used mathematical analysis and practical tests to analyze cutting speed-gripping force relationships. Their findings are reported in *Werkstatt und Betrieb*, Vol. 94, No. 9, 1961, p. 177-185. The title of their article is "Untersuchungen ueber die Grenzdrehzahl handbetaetigter Dreibackenfutter."

The investigation was limited to three-jaw chucks of twelve different types—rotating screw, gear, screw and wedge, eccentrics and cams, and so on. The forces acting at the chuck and the forces acting on the workpiece were analyzed. The latter forces include radial, axial and resultant components. These forces and moments, which depend partially on the cutting force, tend to displace and tilt the workpiece.

Dynamic gripping force can be determined by a formula presented by the authors. This formula takes into account the cutting force, the work and chucking diameters, and the coefficient of friction of jaw and workpiece; also the radial stiffness and tilting resistance of the jaws and their lever arms.

Dynamic gripping force is counteracted by the centrifugal forces, which depend on the mass of the jaws, the radius of the center of gravity and the square of the angular speed. When the speed is increased ten times, the counteracting centrifugal force increases one hundred times.

Chucks should be dimensioned so that they permit transmission of a torque that corresponds to the cutting horsepower and corresponding spindle rpm. The authors found that a small number of teeth of small pitch is preferable to many teeth of large pitch. The stiffness of the chuck with respect to tilting of the jaws increases with the third power of the diameter.

Pahlitzsch and Warnecke also discuss means for increasing the chuck body's resistance to deformation. A sketch appearing with the article shows the dynamometer they used to measure the gripping forces.

The reduction in gripping force with increasing speed is considerable. From diagrams in the article, it is evident that gripping force is reduced about 130 lb at 1000 rpm; 2200 lb at 4000 rpm.

Measuring Without Contact

In April, this column covered several optical instruments that are designed for the measurement of the outside diameters of workpieces without contact. More information on these devices is contained in an article by E. Lepper, appearing in *Technisches Zentralblatt fuer praktische Metallbearbeitung*, Vol. 55, No. 4, 1961, p. 168-170. The title of the article is "Verfahren un Aufbau von Einrichtungen zum beruelhrunglosen optischen Messen von Aussen Durchmessern."

Opposite sides of the outside diameter of the workpiece are illuminated by the instrument Lepper describes. The desired accuracy can be obtained only when the rays of the light at each side are parallel to each other. If they are not parallel, a considerable measuring error, called the sinusoidal error, is introduced. Parallelism can be obtained without elaborate precautions by making use of the optical principle of positive nodes. Tilting a system of optical lenses about a node does not produce a change in direction. Instead, it provides an accurate means of measurement. This principle (the Eppenstein principle) has been utilized in the measuring device, which can be applied on small lathes as well as on vertical boring mills and which covers a range of part sizes from 1 to 6½ inches OD. A larger size that measures parts with OD's up to 80 inches is being made.

A cross sectional drawing appearing with the article shows how the two light beams are adjusted and focused with a precision screw. One of the light beams is red and the other is green. The true diameter is found when the colors disappear. A black line is seen in the objective when the light rays are not touching the workpiece and a white line is seen when the beam and the workpiece overlap. The diameter can be read to an accuracy of 0.0002 inch.

The device can be attached to a lathe and used to make measurements when the workpiece is rotating. Surface finishes and runout do not affect accuracy. It is unnecessary to adjust the instrument horizontally or vertically with respect to the workpiece and it is claimed that deflections do not affect the readings. Work is currently being done to use the method for controlling a lathe by incorporating an electronic feedback device, thus controlling a machine tool by a combination of optics and electronics.

Deformation of Press Frames

To reduce deflections under load, the cross sections of the frames of mechanical presses should be built asymmetrically, according to J. Smolak (Warsaw, Poland), writing in *Werkstatt und Betrieb*, No. 4, p. 193-196. The title of his article is "Zur Gestellberechnung mechanischer Pressen."

Frames of presses with longitudinal driveshafts are particularly sensitive to deformations, due to the fact that the chucking moments are added to the

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external bending moments. In present press designs, frames are built so that the wall thickness of the cross section is uniform (symmetric design). Smolak shows mathematically that the wall thickness should not be uniform—it should be heavier at the inside walls than at the outside walls. Equations and graphs in the article permit the optimum ratio of the wall thicknesses to be calculated. In an example, it is shown that deflections can be reduced by 20 percent and stresses by 30 percent when the asymmetrical design is used.

Automated Cylindrical Grinding

In an article entitled "Automation of Cylindrical Grinding Processes," I. E. Fragin, Russian engineer, discusses many facets of automated grinding. The article, a translation of an article that appeared in *Stanki i Instrument*, appears in *Machines and Tooling*, Vol. 31, No. 6, 1960, p. 9-11.

The basic factor for the proper regulation of the grinding cycle, as established at the Moscow Institute for Machinery, is the radial force exerted by the grinding wheel on the workpiece. Fragin believes that the successful automation of cylindrical grinding operations must be based on controlling this force. He presents a formula for the optimum grinding time cycle, showing that it is affected particularly by the rapid approach of the wheel and the plunge feed until the desired radial pressures are obtained. Other factors involved are the radial pressure during grinding and the dwell.

An equation correlating surface finish and radial force, from which the author determines the optimum dwell, is also presented. As an example, the dwell period should be 0.34 min when grinding a workpiece of about 2-inch diameter and 8-inch length when a surface finish of 44 microinches is desired.

The greatest difficulties encountered in designing automated grinding machines are caused by the need to maintain constant radial force during the grinding operation. Among several ways to maintain this force, the author tried changing the feed of the grinding head, using an inductive pickup to measure the radial force. With this arrangement, a signal is generated when the radial forces exceed a permissible level. A combination electronic and electromagnetic booster actuates a cam mechanism that corrects the radial force.

To increase the sensitivity of the setup, the author equipped the grind-

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ing head slides with antifriction rollers. The speed of approach of the wheel in his automated grinding machine depends on the signals. When finish grinding, that is when the radial force is small, the infeed is 0.04 to 0.06 ipm, in rough grinding, with a radial force of about 88 lb, the plunge feed is increased to 0.16-0.24 ipm. This automated grinding method cut actual grinding time by 90 percent and cut floor-to-floor time 21 percent.

Damping Grinding Vibrations

With the trend toward higher spindle speeds, hydrostatic bearings are being used more commonly on grinding machines. Vibration set up by these air or gas lubricated bearings is a serious problem, particularly in the case of thrust bearings.

S. A. Sheinberg and V. G. Shuster have investigated thrust vibrations practically and mathematically. They report their findings in *Stanki i Instrument*, No. 11, 1960, p. 23. A translation of their article appears in *Machines and Tooling*, Vol. 31, 1960, under the title: "Resistance to Vibrations of a Hydrostatic Thrust Bearing."

Self-excited vibrations are particularly heavy in the axial direction, due to the elasticity of the air contained in the pockets or grooves through which air is supplied. Theoretical investigations by the authors showed that the resistance of a thrust bearing to vibration increases when the volume of gas contained in the pockets is reduced. Such a reduction would also reduce the load carrying capacity. This reduction is avoided with a graphite bearing developed by the authors.

The gas is delivered through the porous body of the bearing, which is used in an electrically driven grinding spindle that has speeds of 48,000, 72,000 and 96,000 rpm. Four practical designs for porous thrust bearings were developed—a solid bearing, a solid bearing with a center hole, an annular bearing, and an annular bearing with a center hole. Calculations for the computation of the bearing pad thickness, the determination of the load carrying capacity at different air pressures, the volumetric air consumption per hour, the volumetric flow rate and other quantities appear in the article.

The main difficulties experienced were caused by the varying quality of the graphite. While the permeability of graphite is of little concern in the usual applications of graphite, it is important when graphite is used for hydrostatic thrust bearings. Consequently, manufacturing must be improved.

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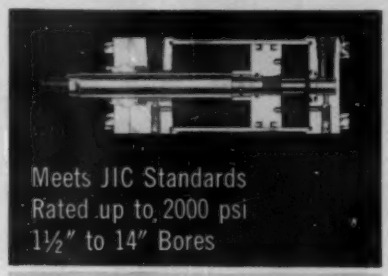

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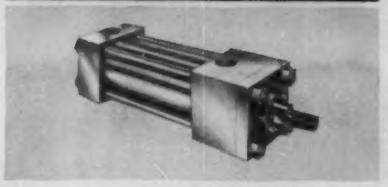

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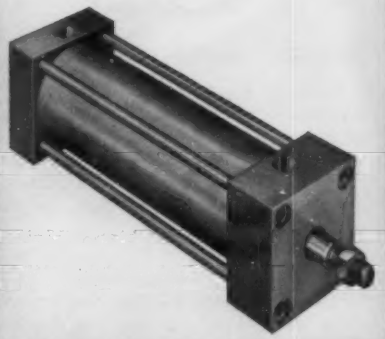

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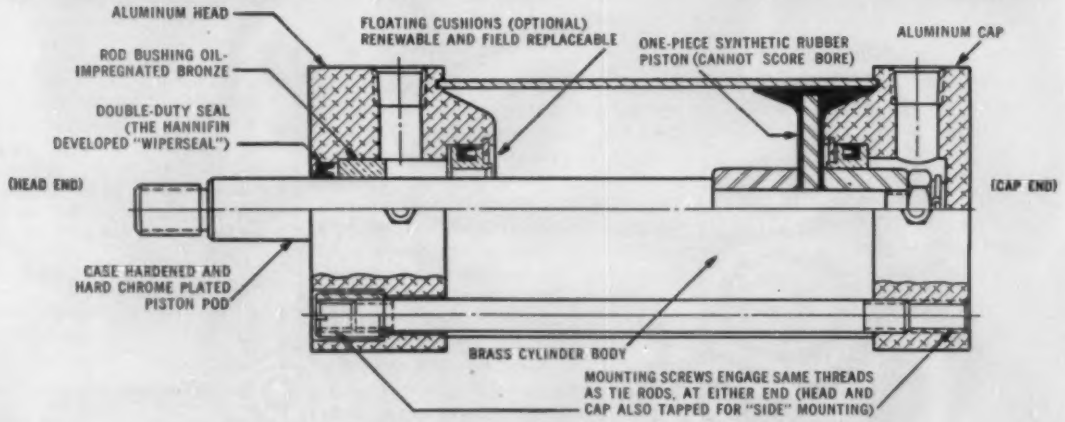
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Trade Literature

for free booklets and catalogs—use request card, page 123

"ONE WAY to Make Your Job a Little Easier" presents helpful facts about making maintenance and repair parts. LaSalle Steel Co. **(Circle 501)** . . . "Shutdown Master Planner"—a wall chart which facilitates scheduling of equipment shutdown maintenance activities—provides space for listing all items involved and time and manpower requirements. Westinghouse Electric Corp. **(Circle 502)** . . . Consisting of a vacuum generator, pencil and pick-ups, System V-100 is a portable unit designed for handling miniature parts. Vacuum Tweezer Co. **(Circle 503)** . . . "Management Guide to Productivity," by discussing seven efficiency-cost ratios, gives ways of measuring materials handling efficiency. Yale & Towne Mfg. Co. **(Circle 504)** . . . Hy-Duty is a two-die machine designed for threading and forming operations requiring rolling pressures of 50,000 to 200,000 lb. Landis Machine Co. **(Circle 505)** . . . Advantages such as replacement and maintenance cost savings, greater work area, elimination of cutter chatter, and increased machine feeds and speeds are offered by a new line of antifriction arbor support bearings. Briney Mfg. Co. **(Circle 506)**

Automation, Mechanization

All standard tape widths and up to eight channels plus sprocket—in either strip, loop or reel tape modes—can be read by a photoelectric tape reader at speeds to 100 ips. It has bidirectional drive and uses chopped reflected light. Omnitronics, Inc. **(Circle 507)** . . . A 48 x 48-inch X-Y plotter is accurate to ±0.001 inch over its entire working surface. Gerber Scientific Instrument Co. **(Circle 508)** . . . A line of high-speed, bidirectional electronic counters —which supplement or, in some cases, replace expensive control systems and complicated mechanical devices—measures displacement, actuated by a rotary pulse generator type of transducer. Veeder-Root, Inc. **(Circle 509)** . . . One feature of an automatic reset dial timer —used for controlling industrial processes, laboratory and machine automation—is a 14-point terminal block. Included in the bulletin is data on construction, installation, application and electrical circuit arrangements. Automatic Timing & Controls, Inc. **(Circle 510)**

Boring, Drilling, Tapping

Problems of locating, boring, grinding and measuring holes to extremely close accuracies are discussed in "Package of Precision." Moore Special Tool Co., Inc. **(Circle 511)** . . . Thirteen high-speed steel, solid carbide and carbide tipped drills, representing over 550 different sizes, have been added to a line of twist drills. American Twist Drill Co. **(Circle 512)** . . . Designed for adaptability and complete freedom of action, a hand tapping machine permits the operator to instantly swing the tap to any point on the table or off the table in the case of large parts or fixtures that overhang. Toolroom Equipment Div., Producto Machine Co. **(Circle 513)**

Casting, Molding

Available either as a hot chamber machine for casting zinc, lead or tin alloys, or as a cold chamber machine for casting aluminum, brass or magnesium alloys, a high pressure hydraulic die casting machine has 40½-inch vertical die plates and 40-inch horizontal die plates, and locking pressure of 400 tons. Cleveland Automatic Machine Co. **(Circle 514)**

Cleaning, Plating, Painting

Six sizes of a batch type airless abrasive blast cleaning machine range in operating load capacities from 7 to 100 cu ft. Wheelabrator Corp. **(Circle 515)**

Cutting Tools

"Standard Shapes, Sizes, Grades and Designations of Cemented Carbide Products"—issued by the Commodity Standards Div., Office of Technical Services, U. S. Dept. of Commerce—gives practice recommendations for 44 standard stock items such as throwaway carbide inserts, saw tips, chisel blanks, die nibs and twist drill blanks. Write to Cemented Carbide Producers Assn., 2130 Keith Bldg., Cleveland 15, Ohio . . . Tantung—a cast alloy compressed of cobalt, chromium, tungsten, columbium and carbon—is well-suited for a wide variety of machining jobs at intermediate cutting speeds. Vascoloy-Ramet Corp. **(Circle 516)** . . . Full information on standard blanks, brazed tools and preformed carbide is given in a catalog. Valenite Metals. **(Circle 517)** . . . "Kendex Tailored Tooling" shows how to use a line of standardized adjustable units with throwaway inserts in multiple insert and special tools designed for specific jobs. Kennametal Inc. **(Circle 518)**

Electric Motors, Controls, Drives

New all-solid-state design of an electronic speed and load sensing governor provides accurate load division during parallel operation. The governor can be used with steam and gas turbines or diesel engines rated between 50 and 50,000 kw with either generator or mechanical drives. General Electric Co. **(Circle 519)** . . . In the event of misfeed, stock buckling or material pile-up, an electrically controlled system instantly disengages the press clutch, thereby preventing damage to dies on power presses. Di-Matic Controls, Inc. **(Circle 520)** . . . A line of fractional horsepower motors spans the rating range from 15 millihorsepower to ½ hp. General Electric Co. **(Circle 521)** . . . An electronic timer is suitable for industrial and laboratory uses involving automatic operation of electric circuits at preselected, adjustable time intervals and sequences. Farmer Electric Products Co., Inc. **(Circle 522)**

Finishing, Grinding

Problems in the selection of the right abrasive media and compounds for use in vibratory and barrel finishing are discussed in a catalog. Roto-Finish Co. **(Circle 523)** . . . Improved 7-inch grinder has safety shields, removable steel plates covering the sides of the wheels, a ½-hp motor and oval end bell hubs. Walker-Turner Div., Rockwell Mfg. Co. **(Circle 524)** . . . The effects of metal damage caused by improper grinding of high-strength aircraft fasteners are detailed in an 8-page technical report. Standard Pressed Steel Co. **(Circle 525)** . . . A bulletin lists right angle and vertical sanders and grinders for contour finishing of dies, molds,

forgings and castings and for deburring machined parts. Dotco, Inc. **(Circle 526)** . . . A line of abrasive belt flat finishers has been enlarged to include models with as many as six heads for work up to 12 inches. Hammond Machinery Builders, Inc. **(Circle 527)** . . . Mounted permanently to practically any standard surface or tool and cutter grinding machine, a new attachment to dress grinding wheels optically uses a 10X microscope to assure a satisfactory blend between radii and angles in forming the wheel. Parker-Hartford Corp. **(Circle 528)**

Inspection, Measurement

Particularly applicable to the inspection of parts such as leadscrews, die bodies, castings and forgings and large circuit boards, a new 14-inch screen optical comparator and measuring machine has projection lenses that are matched and preset for exact rated magnification on master optical benches. Jones & Lamson Machine Co. **(Circle 529)** . . . New tenth plug gaging sets in half-thousandth and thousandth steps are designed for use in measuring bored holes and also as setting standards for comparators, snap gages and micrometers. Deltronic Corp. **(Circle 530)**

Lathes

One model of a heavy duty lathe with single handwheel selection of cutting speed makes shifting gears almost effortless. R. K. LeBlond Machine Tool Co. **(Circle 531)**

Materials

Loctite—an anaerobic polymer—penetrates the small clearances between assembled metal parts and self-hardens into a tough bond which makes the assembly impervious to vibration-loosening. American Sealants Co. **(Circle 532)** . . . A bulletin describing different types of die blocks and hot work steels for all types of forging operations gives information about selecting the right size die block, sinking the impression, setting up the die in the hammer and resinking. A. Finkl & Sons Co. **(Circle 533)** . . . A process of vacuum degassing steel in the ladle and the technique of pouring degassed steel through a blanket of argon gas are discussed in a bulletin. A. Finkl & Sons Co. **(Circle 534)** . . . A bulletin describes how high quality forgings such as a ram for a forging hammer and a steel container and liner for extruding stainless steel at 2300 F temperatures under high pressures are produced. A. Finkl & Sons Co. **(Circle 535)** . . . A technical data sheet discusses the selection of metal powders for sprayed overlays. Wall Colmonoy Corp. **(Circle 536)**

Milling

Feature article of *Report from Cincinnati Milling*, Vol. 18, No. 2, is "Elements of Electrical Machining." Other write-ups include "Dressing Precision Grinding Wheels" and "Building Block Automation." Cincinnati Milling Machine Co. **(Circle 537)**

Sawing, Shearing

Features of all three models of a double mitre saw include a 39-inch working height and recessed knee control. They are constructed to receive their own scrap and their arbors are supported on both sides by four high-speed bearings. Saw blade is adjustable. LeTarte Co., Inc. **(Circle 538)**

Workholders, Fixtures

A brochure describes a complete line of standard screw machine tools including centering tools, revolving stops, turret bushings, full-floating reamer bushings, drill holder bushings and slotting bushings and adapters. Mueller Industries. **(Circle 539)**

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HACKENSACK — The Eaton Company
INDIANAPOLIS — Donald McIntire
MEMPHIS — Branch-Burnside Tool Specialists
MILWAUKEE — Ford Tool Company
MONTREAL — Humphrey E. Walton
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who's meeting and where

Aug. 6. Industrial research conference, sponsored by COLUMBIA UNIVERSITY. Arden House, Harriman, N. Y.

Aug. 7-9. Conference on guidance and control, sponsored by AMERICAN NUCEEAR SOCIETY and STANFORD UNIVERSITY. Stanford University, Stanford, Calif.

Aug. 14-17. SOCIETY OF AUTOMOTIVE ENGINEERS. National west coast meeting. Sheraton Hotel, Portland, Ore.

Aug. 22-25. Western Electronics Show and Conference, sponsored by INSTITUTE OF RADIO ENGINEERING and WESTERN ELECTRONIC MANUFACTURERS ASSN. Cow Palace, San Francisco, Calif.

Aug. 23-25. AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. 1961 Pacific general meeting. Hotel Utah, Salt Lake City, Utah.

Aug. 23-25. Fourth biennial gas dynamics symposium, sponsored by AMERICAN ROCKET SOCIETY and NORTHWESTERN UNIVERSITY. Northwestern Technological Institute, Evanston, Ill.

Aug. 27-Sept. 1. Short course on materials under thermal stress, conducted by the PENNSYLVANIA STATE UNIVERSITY department of engineering mechanics. University Park, Pa.

Aug. 28-30. Conference on subcritical assemblies, sponsored by OAK RIDGE NATIONAL LABORATORY, OAK RIDGE INSTITUTE OF NUCLEAR STUDIES and AMERICAN NUCLEAR SOCIETY in cooperation with U. S. ATOMIC ENERGY COMMISION. Gatlinburg, Tenn.

Aug. 28-30. Sixth symposium on ballistic missile and aerospace technology, sponsored by AEROSPACE CORP. with the AIR FORCE BALLISTIC MISSILE DIV. University of Southern California, Los Angeles, Calif.

Aug. 28-Sept. 1. International heat transfer conference, sponsored by AMERICAN SOCIETY OF MECHANICAL ENGINEERS, AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, INSTITUTION OF MECHANICAL ENGINEERS, and INSTITUTION OF CHEMICAL ENGINEERS. University of Colorado, Boulder, Colo.

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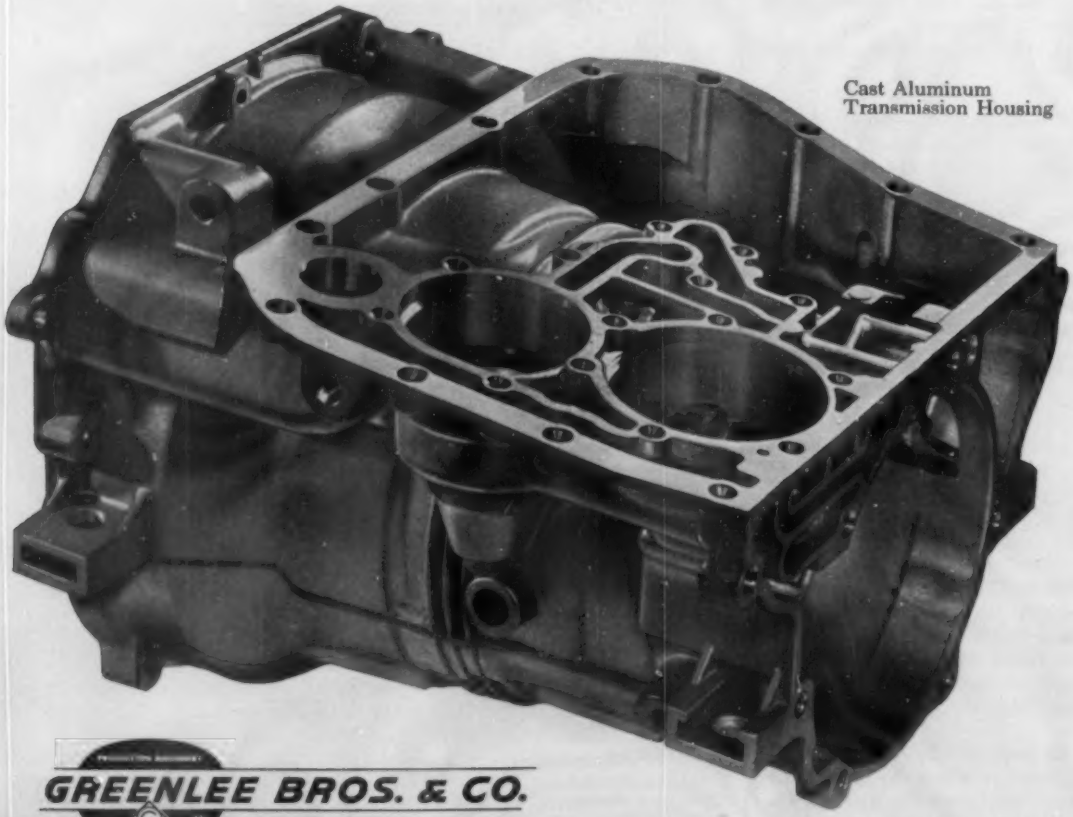

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Field Notes

STANDARDS WORK in the fields of numerical control of machine tools and process control computers will begin later this year, pending approval of the new project by the Miscellaneous Standards Board of the **American Standards Assn.** Recommended by 12 user and producer associations in the electronic data processing field at a general conference, the project would concern computers and related equipments in two principal application areas—industrial process control and machine tool numerical control. Under the sponsorship of the **Electronic Industries Assn.**, the project would also aim at solving problems relating to electrical characteristics of data transmission and input-output media.

expansions

Confirmation of a $6,000,000-expansion program to provide a new bearings manufacturing plant near Clinton, S. C., and a wire mill adjacent to its Broad St. plant in Torrington has been made by **Torrington Co.**, Torrington, Conn. Production at the Clinton plant will include needle bearings and needle rollers for the automotive, farm implement, outboard engine, power tool and other industries using antifriction bearings.

Ownership interest in **W. A. Deutsher Pty. Ltd.**, Victoria, Australia, has been acquired by **Illinois Tool Works** of Chicago, Ill. Deutsher produces screw machine parts, such as valve fittings and industrial fasteners. The company will, in addition, produce an expanded line of fasteners for the automotive, appliance and electrical industries in Australia—the same industries serviced by Illinois Tool Works in the United States.

Madison Industries, Inc., Providence, R. I., originators and manufacturers of Madison tools, has announced the licensing of **Birmingham Tool & Gauge Co., Ltd.**, Birmingham, England, to manufacture and sell the full line of Madison tools and accessories in England. The contract brings together two companies with many years of experience in designing and manufacturing cutting tools for the metalworking industry.

The formation of a new division, **United Machines and Engineering Inc.**, to be located in Fort Smith, Ark., by **United Welders, Inc.**, Bay City, Mich., has been announced. General offices, engineering department and building areas are being included in a new plant now being constructed. The new division will specialize in design and fabrication of highly automatic equipment for handling and transfer of in-process workpieces, plastics part manufacturing, application of chemical-foam insulation and special machining operations.

name changes

Kamlar Products Co. has changed its name to **Kamweld Products Co.** The designation Kamlar as a tradename has been discontinued, and is replaced with Kamweld. The Norwood, Mass., company manufactures welding equipment and high-speed tools for thermoplastics.

Pyronics, Inc., is the new name adopted by **Bryant Industrial Products Corp.**, Cleveland, Ohio, manufacturer of combustion systems, including industrial gas burners, controls, components and assemblies. The new name was selected to reflect the company's engineering, marketing and sales philosophies and accomplishments.

Hydraulic Press Mfg. Co., Div. of Koehring Co., has changed its name to **H-P-M Div., Koehring Co.** Sales, administration and manufacturing will continue at the firm's plant in Mt. Gilead, Ohio.

acquisitions

Magnetic Powders, Inc., Johnsonburg, Pa., manufacturer of iron powders, has been purchased by **Glidden Co.**, from **Radio Cores, Inc.**, Oak Lawn, Ill. The acquisition improves and broadens the Cleveland, Ohio, company's position in the metal powders field.

Air Reduction Co., Inc., New York, N. Y., and **Speer Carbon Co.**, subject to the approval of each company's board of directors, have agreed to the acquisition by Air Reduction of Speer Carbon's assets and business in exchange for Air Reduction common stock at the rate of one share of Air Reduction stock for each 2.25 shares of Speer Carbon stock. Air Reduction is a producer of industrial gases, welding and cutting equipment, medical gases and equipment, and chemicals. Speer Carbon, who produces carbon and graphite products, as well as products used in the electronics industry, will continue to be operated by present management from its headquarters at St. Marys, Pa.

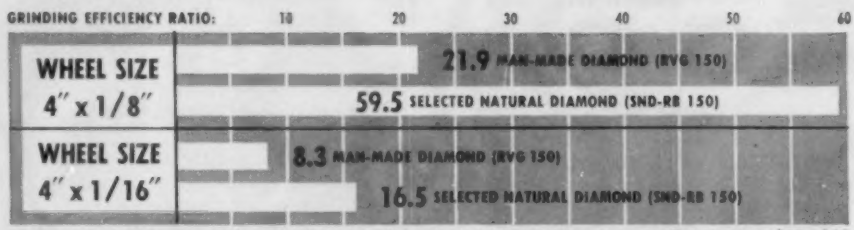
Covel Mfg. Co. of Benton Harbor, Mich., has announced that it has acquired from **Wade Tool Co.** of Waltham, Mass., their line of precision lathes consisting of hand turret lathes, finishing lathes and toolmakers lathes. Manufacturing, sales and service will be moved to Benton Harbor.

association news

At its election of officers for 1961-62, **American Gear Manufacturers Assn.** elected the following officers: president, C. F. Bannan, Western Gear Corp.; vice president, products division, J. Harper Jackson, Jackson Gear Co.; vice president, technical division, F. Richardz, Westinghouse Electric Corp.; treasurer, R. C. Ball, Jr., Philadelphia Gear Corp.; and executive director, J. C. Sears, AGMA Headquarters. Elected to the board of directors were E. Jack Borisch, Milwaukee Gear Co.; Duncan Dorris, George P. Dorris Co., Inc.; Robert M. Honegger, Farrel-Birmingham Co., Inc.; and Robert E. Smallwood, Dominion Engineering Works, Ltd.

Drop Forging Assn., Cleveland, Ohio, elected its officers for the coming year. William A. Carlile, Jr., Columbus Bolt & Forging Co., was named president. Walter H. Stocking, Pittsburgh Forgings Co., is now association vice president. Named to the executive committee with Carlile and Stocking were Arthur G. Tichenor, American Brake Shoe Co.; Roland J. Ahern, Billings and Spencer Co.; James Dalrymple, Dominion Forge Ltd.; Alan J. Diemer, Jr., Mondie Forge Co., Inc.; and E. C. Rork, Precision Forge Co. Included in the association's plans is the promotion of formal education and scientific research in subjects identified with the forging industry through the newly formed Forging Educational Foundation. The foundation will make available scholarships, as well as laboratory equipment, and will undertake the sponsorship of college textbooks in forging technology.

Tests prove... SND (Selected Natural Diamond) doubles cup wheel life and output in carbide tool grinding



TEST CONDITIONS—Dry Grinding • WHEELS: Cup Type-D6A9 • SPINDLE SPEED: 3600 RPM. (3800 S.F.M.) • DOWNFEED: .0015" • MATERIAL: ½" x ¾"

One wheel with SND (Selected Natural Diamond) does the work of two wheels containing man-made diamond in carbide tool grinding!

The unequalled performance capabilities of SND —the most advanced development of diamond technology—are now proven indisputably in *realistic* tests with cup wheels, conducted under shop-use conditions that apply in your own tool grinding operations.

Performance results, charted here, provide positive proof that SND assures unmatched efficiency and economy in precision grinding procedures. As shown, SND outperforms man-made diamond with up to *98% greater grinding efficiency in 1/16" rim cup wheels*... with up to *172% greater efficiency in 1/8" rim cup wheels!*

To the diamond wheel user, this means that SND doubles or triples wheel life and output over man-made diamond cup wheels... insuring wheel cost savings of at least 50%!

Your diamond wheel supplier has the knowledge and experience to help you select SND (Selected Natural Diamond) in wheels best suited to your particular requirements.

To keep up to date on latest developments in industrial diamond technology—including indisputable test results that prove SND superiority—write for Engelhard Hanovia's technical bulletins.

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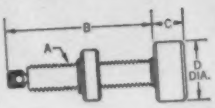
The perfect holding tool—combines torque-limiting feature of Vlier Torque Thumb Screws and the surface-protecting pad of Vlier Swivel Pad Clamps. Exclusive ball-joint construction. Available as standards in four sizes.



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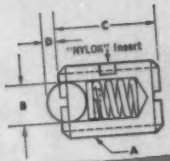
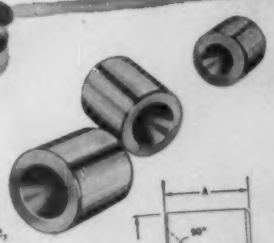
TS-103	¼-20	2⅛	3/16	3/8	12-14
TS-103-A	5/16-18	2¼	3/16	3/8	14-16
TS-104	3/8-16	2¼	3/16	3/8	16-18
TS-107	½-13	3	½	1½	18-20

National Coarse Thread Series Class #2A fit.

NEW! All Stainless Steel Ball Plungers

Available as standards in 10 sizes from 4-48 x 3/16" to 5/8-11 x 1"; standard end pressures. Special sizes and end pressures also available.





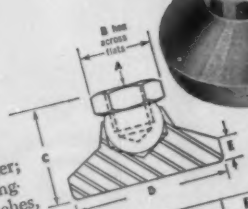
NEW! Hardened Ball Buttons

The perfect, ready-made, easy-to-install detent for use with Vlier Ball Plungers. Available in eight sizes.

ITEM NO.	FOR VLIER BALL PLUNGER NO.	A	B +.0002 −.0000
BB-46	B-46, B-47	1/8	.1075
BB-48	B-48	1/8	.1175
BB-50	B-50, B-52, BL-52, BH-52	3/16	.1614
BB-52	B-54, BL-54, BH-54	¼	.2034
BB-54	B-56, BL-56, BH-56	3/16	.2659
BB-56	B-58, BL-58, BH-58	3/8	.3284
BB-58	B-60, BL-60, BH-60	½	.4378
BB-60	B-62, BL-62, BH-62	5/8	.5472

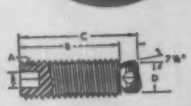
NEW! Leveling Pad

2½" in diameter; ideal for leveling machines, benches, electronic racks, etc.



ITEM NO.	A	B	C	D	E	LOAD, LBS.
P308B	⅝-11UNC-2B	⅛	1⅛	2½	3/16	10,000

NEW! A Miniature Socket-Set Swivel Pad Clamp... only 10-32 x ½"!



ITEM NO.	A	B	C	D	E	LOAD, LBS.
SC-324	Class 2 fit 10-32	11/32	½	.146	Hex 3/32	500

ask your

distributor for complete information TODAY!

NEW FAST DRAW TECHNIQUE CUTS FABRICATING COST OF MAGNESIUM

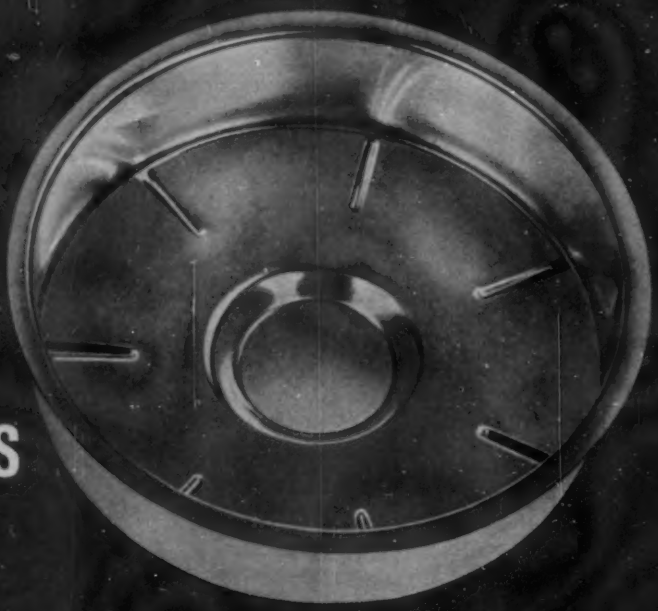
Magnesium parts are now being deep-drawn experimentally at high speeds with a newly-developed process. It uses standard mechanical presses, moderate temperatures (400°F.) and ordinary soap-type lubricants. The part illustrated below was drawn and ejected in 1½ seconds.

This technique cuts the cost of fabricating cylindrical parts of magnesium—with its unparalleled combination of light weight, stiffness and strength. Draws to a 50% reduction are made readily at normal production speeds with a minimum of die stages.

The new technique is expected to find use for many drawn magnesium parts, including components of appliances and business machines. Find out what it can do for you. Write THE DOW METAL PRODUCTS COMPANY, Midland, Mich., Merchandising Dept. 1109FJ8.

FROM BLANK...

TO PART...



IN 1½ SECONDS CYCLE TIME

DOW **THE DOW METAL PRODUCTS COMPANY**

Division of The Dow Chemical Company

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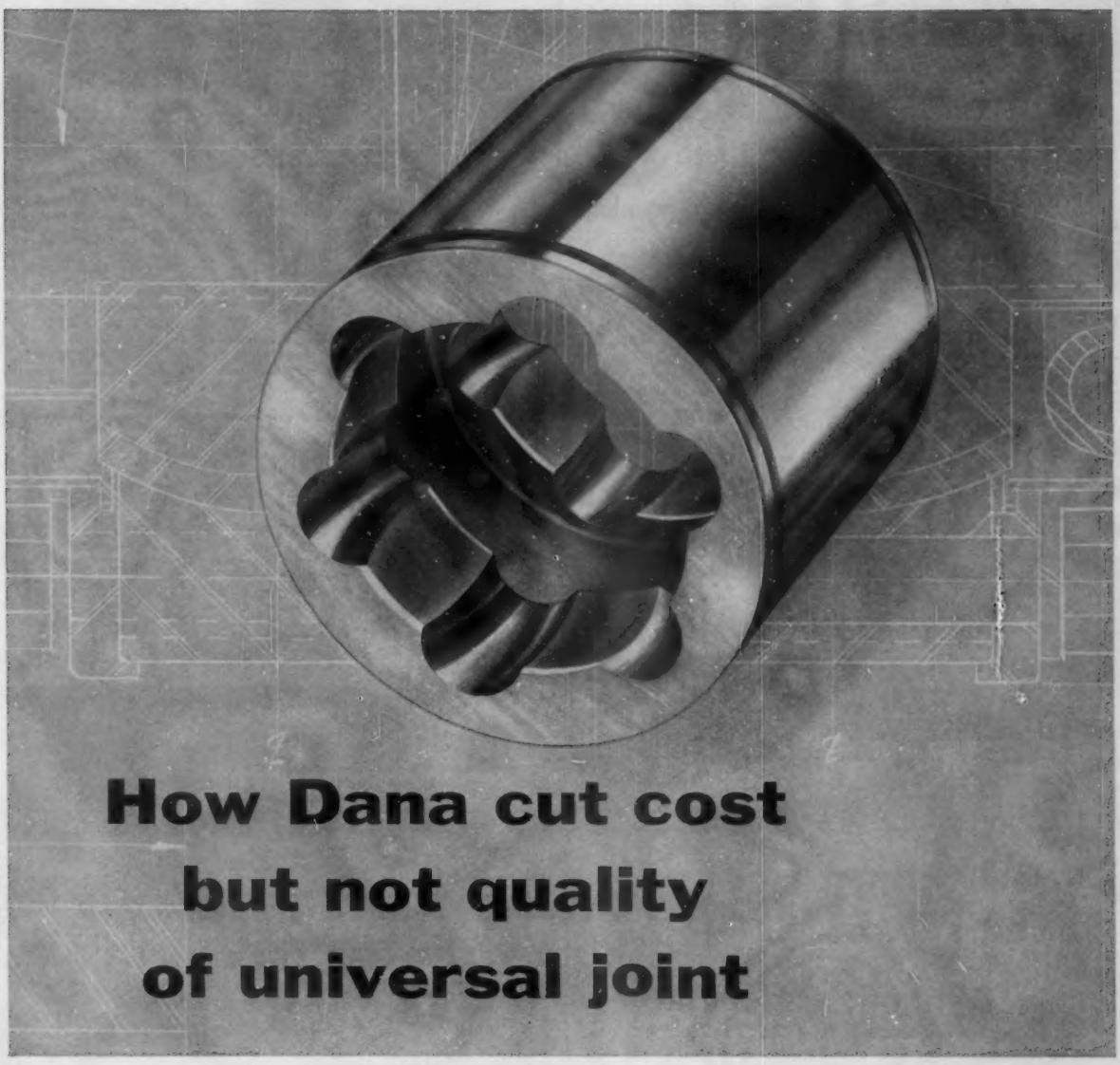

How Dana cut cost but not quality of universal joint

Before the development of the constant velocity universal joint, transmitting uniform rotary motion through a varying angle from shaft to shaft was unsatisfactory at best. Now this type of joint has hundreds of successful applications, including marine and aircraft, road building and mining machines, and machine tools. And with Dana Corporation's Con-Vel Division Rzeppa universal joints, motion transmission is virtually vibration-free. Their disc-type double joint, made from two forged and machined single units coupled together, had one probem—high manufacturing cost. Dana wanted to reduce this cost while maintaining quality.

After consulting with Timken Company metallurgists, Dana redesigned and switched to Timken® seamless steel mechanical tubing for the double outer race of the disc. Savings were immediate and sizable. With the tubing, there's no hole to drill, less machining. Quality was maintained and strength actually increased because of the fine forged quality of Timken rotary-pierced tubing.

Find out how versatile Timken seamless steel tubing—targeted during manufacture to your end use—can save you time and money on your hollow parts. Write: The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable: "TIMROSCO". Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.

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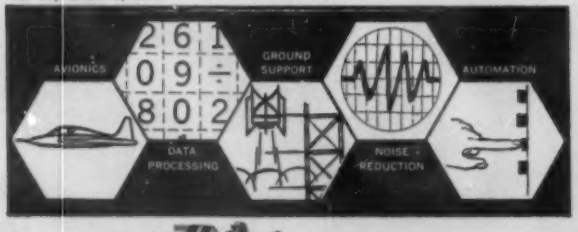

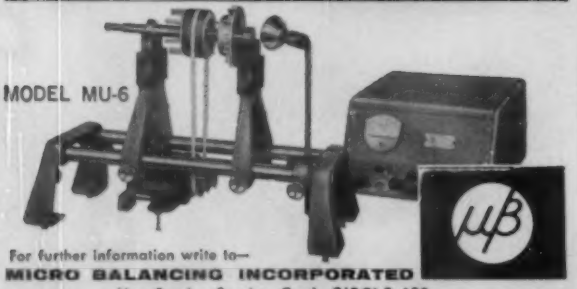

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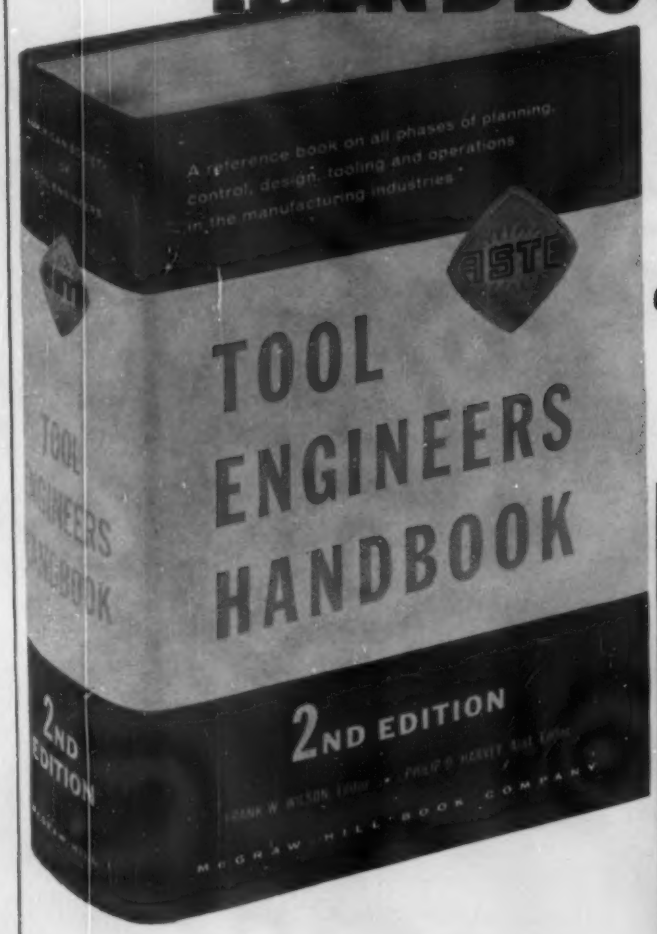
10700 Puritan Avenue • Detroit 38, Michigan

TOOL ENGINEERS HANDBOOK


A reference book on all phases of planning, control, design, tooling and operations in the manufacturing industries
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2289 pages, 6 x 9,
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1000 Tons High Alloy Steels
PRECISION-SHEARED Monthly

1/16" to 1-1/8" Thicknesses Cut Efficiently on Steelweld Shear

Steelweld mechanical shear No. 24GA-12 cutting a 9/16" x 124" plate of 304 chrome nickel.

Some interesting details of this machine:

Capacity 1½" x 12'-0" mild steel — 8" stroke — 21 strokes per minute — 48" motorized back gauge — 20'-0" squaring gauge arm — 7'-0" front gauge outriggers — slitting guide — centralized lubrication system — air-operated ball transfers.

Adjusting gap between knives to provide correct clearance for plate thickness being cut. This adjustment is made in seconds, not hours, as required for some shears. Indicator has scales reading in plate thicknesses and in thousandths of an inch knife clearance. Note convenient up-front location of this important feature.

Addition of a Steelweld Shear boosted shearing capacity tremendously for Jessop Steel Company, Washington, Pa. More than 1000 tons of fine quality stainless, tool, high-speed and related alloy steels for which this 60-year old producer is noted, are sheared monthly on this machine — and every cut is sharp, straight, accurate.

The shear works continually 16 hours a day, 5 days a week, cutting thicknesses from 1/16 to 1⅛ inch. Frequently plate up to 240 inches long are slit by use of the Steelweld slitting arrangement.

The three Steelweld features most impressive to Jessop officials are:

1. The fast easy knife adjustment which can be quickly set to provide the best cut for every plate thickness.
2. The immediate, positive operation and long trouble-free life of Steelweld's air-cooled clutch and brake.
3. The massiveness and rigidity built into the frame and all working parts.

Jessop Steel has found that knives last three times as long on its Steelweld because of the knife adjustment feature. This means an important saving in knife costs, as well as a big reduction in down-time normally required for rotating or changing knives.

"A very fine operating shear" . . . "A machine that is doing a good job for us" . . . These are some of the comments of Jessop Steel production executives.

Steelweld Shears are available in all sizes for cutting steel plate to thicknesses of 2" and in lengths to 30'-0".

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PIVOTED BLADE *Mechanical and Hydraulic* **SHEARS**

Steelweld Machinery includes: Mechanical & Hydraulic Shears and Press Brakes, One-, Two- and Four-Point Straight-Side Presses, Speed-Draw Presses.

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UNIVERSAL BORE GAGE is a simple holder to which any "Last Word" type indicator can be attached. For checking bores, O ring or snap ring grooves, thread reliefs, undercuts, etc. Range, with extensions, .200" to 6.000". Satin finish. With 4 pairs of points, wooden case, extensions, indicator. $48. Without indicator, $24.

CUTTER GRINDING FIXTURE for surface grinders. Sharpens all standard milling cutters up to 6" diameter. With bushings for ⅞", 1" or 1¼" bores, $45.

SWIVEL WHEEL DRESSER swings from 0 to 8" above chuck without cranking grinder spindle up and down. Adjusts either side of wheel, then locks. Precision ground, semi-steel base and arm casting. Serrated diamond chucks of hardened steel. With diamond, $40.

MACHINISTS' STEEL SQUARES. Save more than half the usual price! Accurate squares from England are precision ground all over with hardened and tempered blades.

2", $4.	8", $10.	24", $52.
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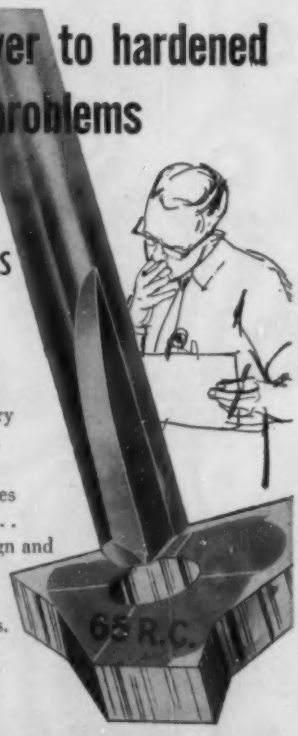
Give these FORD "HI-ROC" drills a trial run in your shop. See how many *more* accurate holes you will drill before regrinding is necessary . . . even in metals to 65 R.C. and 280,000 PSI tensile. Choose from 50 standard sizes in lengths from 1½" to 7" . . . or have FORD engineers design and produce "HI-ROC" drills, ground from solid carbide, to your specific requirements.



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Checking closely on tolerances, time and dollars? These accurate, versatile, low-cost machines can pay their way on your jobs. To see a Delta Metal Lathe in action, write for the name of your nearest Delta Lathe Dealer and get a FREE CATALOG: Rockwell Manufacturing Company, Power Tool Division, 620H North Lexington Avenue, Pittsburgh 8, Pennsylvania.

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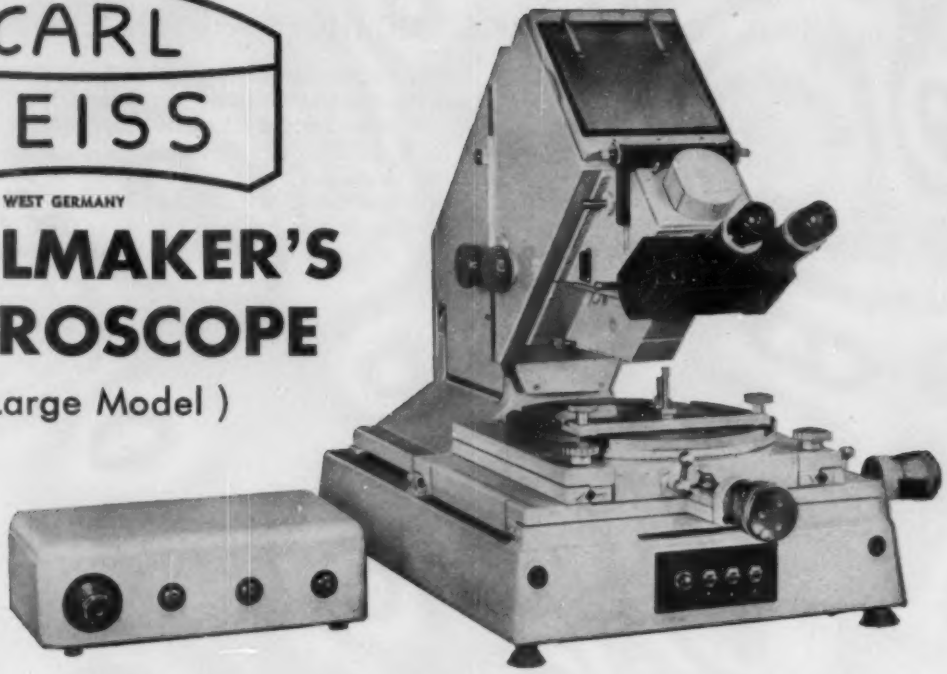
(Large Model)



A decided advance over former instruments

Measuring range of 3x6" permits extensive application

Small toolmaker's microscope also available.

This large toolmaker's microscope, made by Carl Zeiss, offers utmost ease, rapidity and great reliability of measurement.

Its new built-in gauge block displacement device makes it possible to quickly move the stage in the longitudinal direction in five steps, and in the transverse direction in two steps, thus eliminating the old fashioned method of interchanging gauge blocks. All manipulations, adjustments and readings are performed from the same position in front of the instrument.

The inclined binocular tube can be tilted and adjusted to suit the convenience of the operator. During tilting, the image in the eyepiece always remains in focus. The object to be tested is seen simultaneously with the cross-line of the protractor. The scale of the protractor and templet, however, can be projected consecutively into the eyepiece.

BUILT-IN BEAM-SPLITTING DEVICE

Another novel feature of this instrument is the new built-in beam-splitting device with single or double reversed image in complementary colors for line-symmetrical or center-symmetrical measurements.

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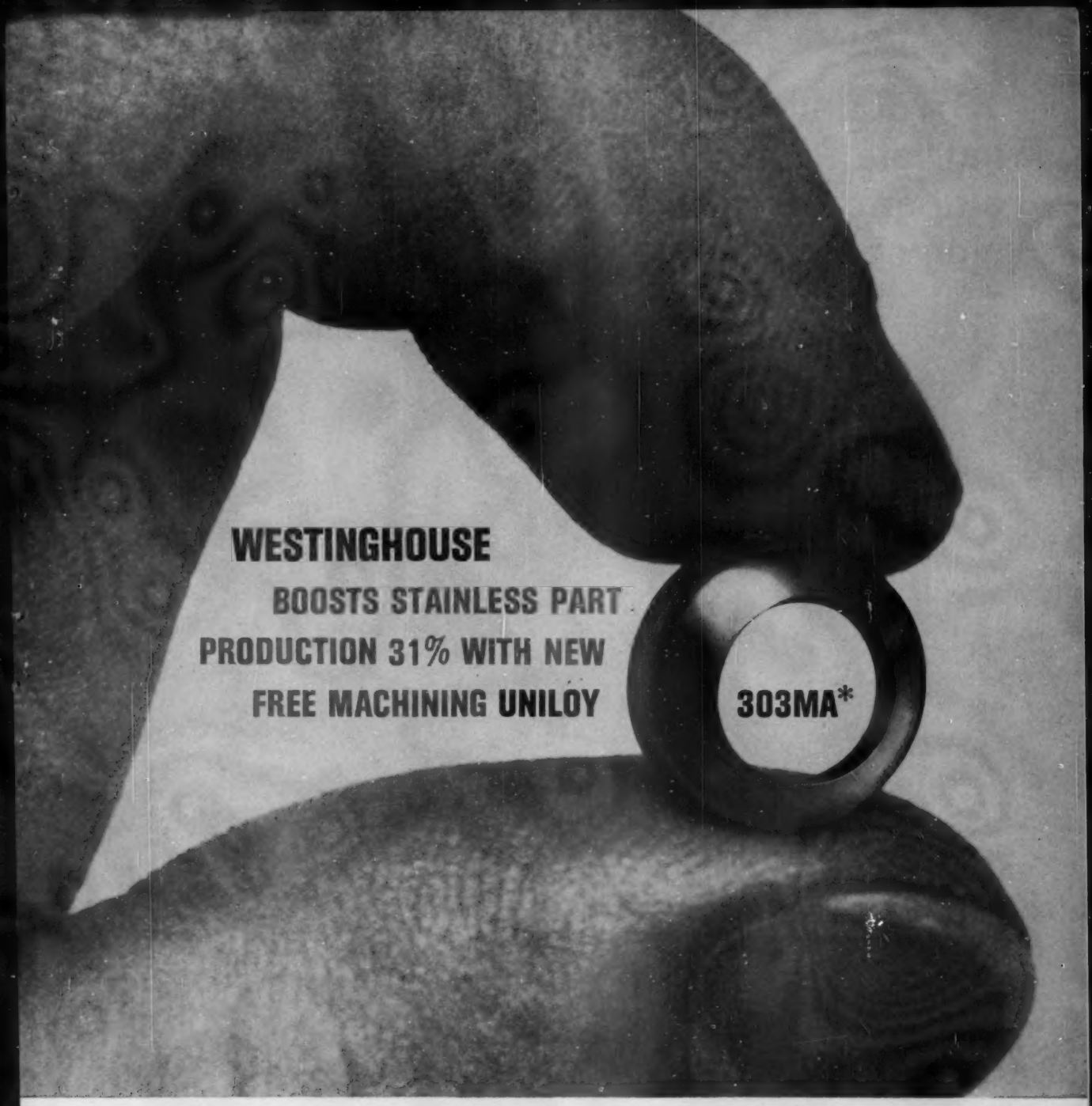

The Westinghouse Standard Control Division at Beaver, Pa., compared New free machining Uniloy 303MA* stainless steel with regular Type 303. The part—a close tolerance spring end support for circuit breakers and control equipment—was machined from ⅛-inch stock. Here are the production line results:

	AISI Type 303	New Uniloy 303MA
Spindle Speed	890	1180
Surface Ft. per Min.	115	155
No. Pieces per Hour	110	144
Tool Life	Form tool sharpened 3 times every 8 hours	Form tool sharpened once every 6 hours

New Uniloy 303MA also machined cleaner and smoother to produce higher quality parts. It is now specified in all applications formerly calling for Type 303 stainless steel at this plant.

Cut *your* production costs! Order New Uniloy 303MA at your nearest Universal-Cyclops steel service center or sales office. Ask for your copy of the "Uniloy 303MA" brochure.

*U.S. PATENT NO. 2,900,250

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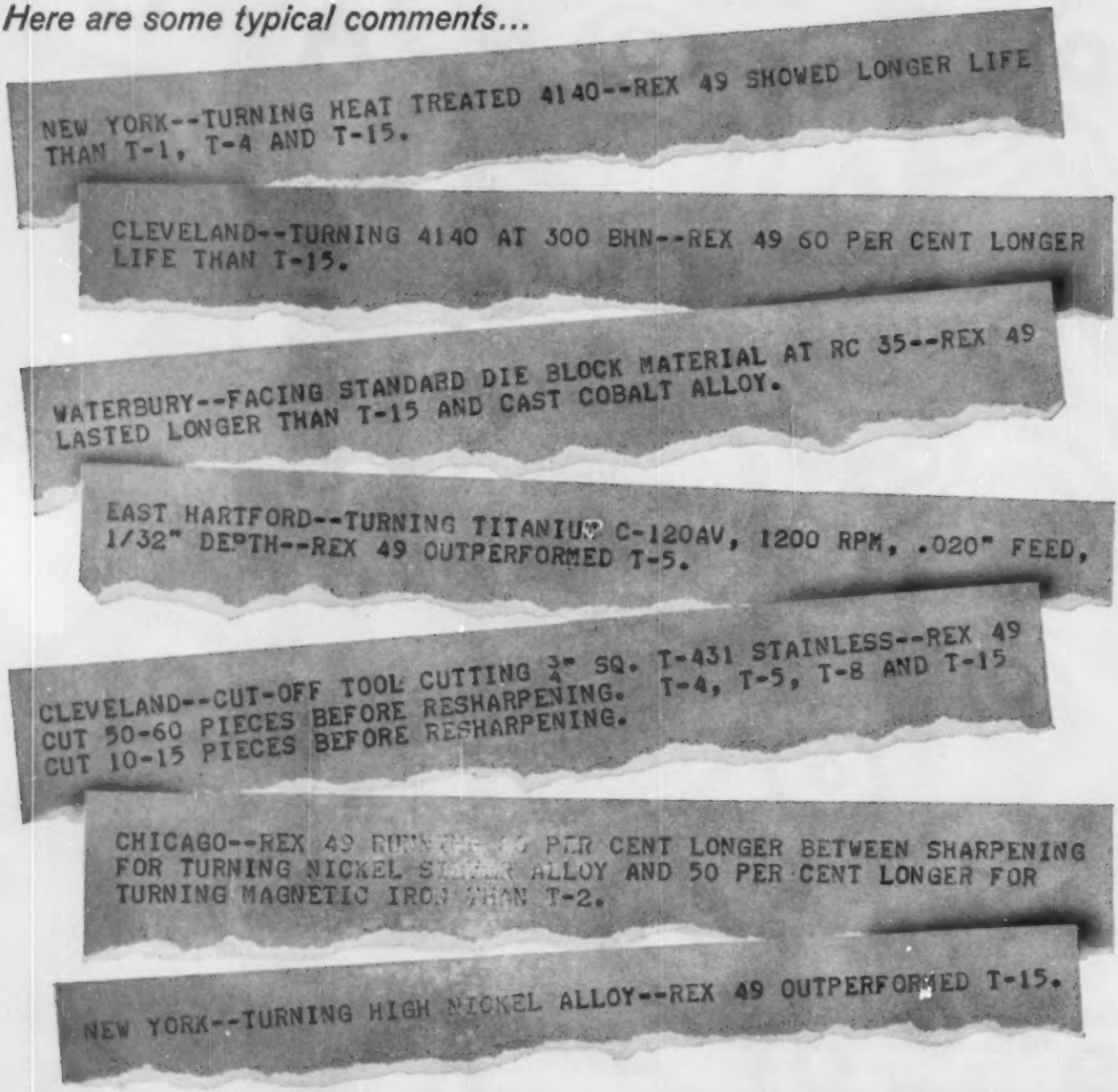
73% of first field reports indicate REX® 49 outperforms other high speed steels

Here are some typical comments...


NEW YORK--TURNING HEAT TREATED 4140--REX 49 SHOWED LONGER LIFE THAN T-1, T-4 AND T-15.
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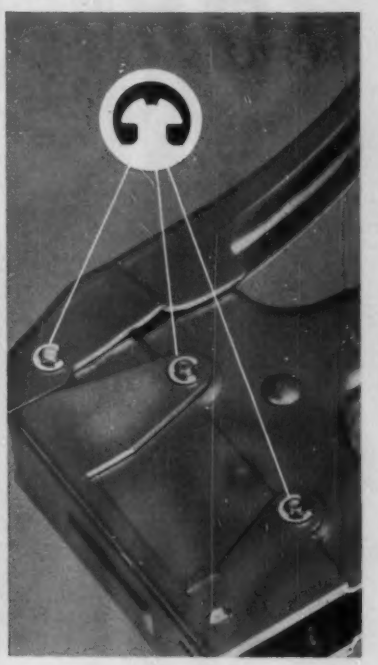
CLEVELAND--CUT-OFF TOOL CUTTING 3/4" SQ. T-431 STAINLESS--REX 49 CUT 50-60 PIECES BEFORE RESHARPENING. T-4, T-5, T-8 AND T-15 CUT 10-15 PIECES BEFORE RESHARPENING.
CHICAGO--REX 49 RUN
PER CENT LONGER BETWEEN SHARPENING FOR TURNING NICKEL
ALLOY AND 50 PER CENT LONGER FOR TURNING MAGNETIC IRON
T-2.
NEW YORK--TURNING HIGH NICKEL ALLOY--REX 49 OUTPERFORMED T-15.

REX 49 is readily available from local Crucible steel centers. Call the Crucible technical service engineer nearest to you to find how you can benefit with REX 49. *Crucible Steel Company of America, Dept. HH26, Four Gateway Center, P. O. Box 88, Pittsburgh 30, Pennsylvania.*

CRUCIBLE STEEL COMPANY OF AMERICA

Here's how ARROW FASTENER Co. gets Truarc® Retaining Rings FREE!



U.S. PAT. NO. 2,837,812

Mechanized Ring-O-Mat® designed by Truarc Engineers doubles stapler production for saving of $2500/year

Arrow Fastener Co., Inc., Brooklyn, N. Y., uses three Truarc Series 5144 reinforced E-rings to secure components in its Model T-50 compression stapler. Originally, Arrow operators installed the rings by hand with conventional applicators and dispensers. Fast? Sure — but Truarc engineers suggested to the company how the job could be done even faster and more economically by mechanizing the entire ring assembly operation.

Working closely with the Arrow engineering and production staff, Truarc mechanization engineers designed the unique Ring-O-Mat shown above. The unit installs the three E-rings in a single operation, twice as fast as the former hand method. Savings with the equipment are $2500 a year — enough to pay for all the rings the company uses!

Here's how the Ring-O-Mat works. The Truarc rings are supplied in tape-wrapped Rol-Pak® cartridges which are loaded on vertical magazine rails at the center of the unit. To install the rings, the operator merely places the stapler in a nest at the front and pushes the control buttons . . . the Ring-O-Mat does the rest! Applicators connected to the air cylinders grasp the bottom ring in each stack and move forward, seating the rings in accurately located grooves pre-cut in pivot pins extending through the body of the stapler. When the rings are fully seated, the applicators are withdrawn automatically and the operation is completed. Simple, fast, fool-proof — a typical example of how Truarc retaining rings lend themselves to mechanized assembly. A good example also of how you get *more* than a fastener when you buy Truarc!

Interested in getting your retaining rings FREE?

Bulletin 459-13 describes a number of assembly techniques for mass-production ring installation. Write for a copy or see your Truarc representative.

WALDES KOHINOOR, INC.

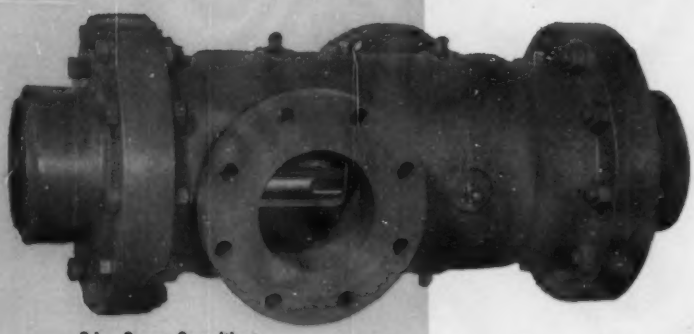
47-16 Austel Place, Long Island City 1, New York

61-5

BIG CONTROL VALVES

up to 8 in. • 5000 psi

2 in., 3-way 3-position, double solenoid type.



8 in., 2-way 2-position, double pilot cylinder type.

Need more flow capacity than you can get with the largest sizes available in most valve lines? There's an easier answer than resorting to costly multiple valving, or redesigning your system to suit flow limitations.

Hunt builds valves in sizes up to 8 in., with air flow ratings of *more than 32,000 cfm* @ 100 psi pressure drop! In fact, you can choose from valves ranging in size from ⅛ through 8 in.; 2 and 3-way, 4-way 2 or 3-position; solenoid, remote-pilot or mechanically actuated; with a variety of optional mountings and features.

If control of large volumes of air, oil, water, or soluble oil and water at pressures up to 5000 psi hyd. is one of your requirements, it'll pay you to talk to your Hunt representative. His specialized knowledge can save you hours and dollars. Call him today.

For more information, write for Bulletin 603. Address Hunt Valve Company, Salem, Ohio, Dept. TE-861.

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VALVES

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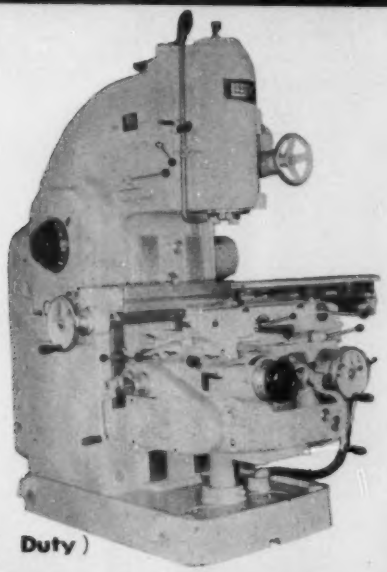
3030

MODEL 2ML VERTICAL MILLING MACHINE



(Medium Duty)

Working Surface (Table)	$53\frac{5}{32}$" x $12\frac{13}{64}$"
Main Spindle Speeds (21 different speeds)	33-2,000 rpm

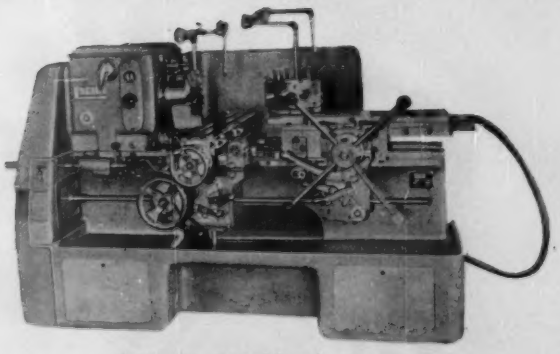
1) Changing speeds of spindle are controlled by the hydraulic system of the shifting gear. Jump select is easily operated by setting the selector dial. Change of meshing gears is controlled by the synchromesh system so that the gears can mesh safety and thoroughly.
2) The feed rate is selected with a stepless changing feed.
3) The longitudinal movement of table can control the automatic cycles; the change of rapid traverse, the change of feed direction and the stop according to the combination of dogs.

World's best **TURRET LATHES**
MILLING MACHINES *brought to you*
by **HITACHI SEIKI**

MODEL 4A UNIVERSAL TURRET LATHE

Collet Chuck Capacities (Round Stock)	2"
Chuck Capacity (3 Jaw scroll cnuck)	10"
Spindle Speeds (16 different speeds)	40-2,000 rpm

It is possible to select easily and speedily 16 different speeds from 40 rpm in minimum to 2000 rpm in maximum with a mono-lever connected to the reversal braking motion of motor.



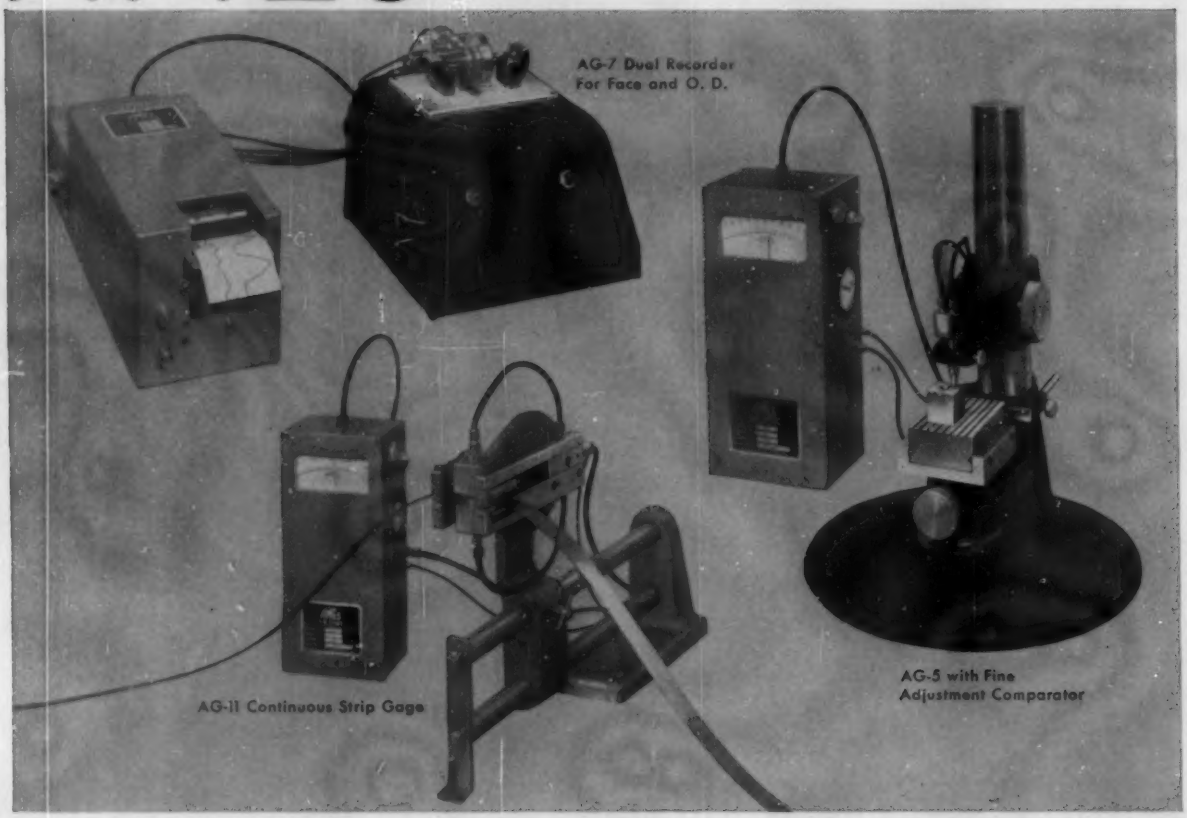
(Chuck Machine)

SEIKI **HITACHI MACHINERY CO., LTD.**

For detailed information, please write Sole Export Agent: HAKKO CO., LTD.

Cable: HAKKOMACHINERY Phone: 201 2141 Room 555, Marunouchi Bldg., Tokyo, Japan.

AMES *Masters of Measurement*



ACCU-FLOW AIR GAGING EQUIPMENT

The new line of ACCU-FLOW air gages developed by B. C. Ames includes several patented components, including nozzles and pressure indicators, which give these gages unusual range and exceptional linearity.

Special Models are Available for Checking: outside and inside diameters, center distances, flatness, roundness, hole depths and continuous non-contact measuring or comparing of paper, metals, plastic films, etc.

Ames ACCU-FLOW Air Gages are providing the answer to many measuring problems that were once considered impossible to solve. For complete information on the entire line of Ames air gaging equipment, write for new ACCU-FLOW folder. *You're asking for the best when you specify Ames!*

B. C. AMES CO., Waltham 54, Mass. Representatives in Principal Cities—
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MANUFACTURERS OF MICROMETER DIAL INDICATORS, DIAL GAUGES, ACCU-FLOW AIR GAGES, PORTABLE TRANSISTORIZED COMPARATORS

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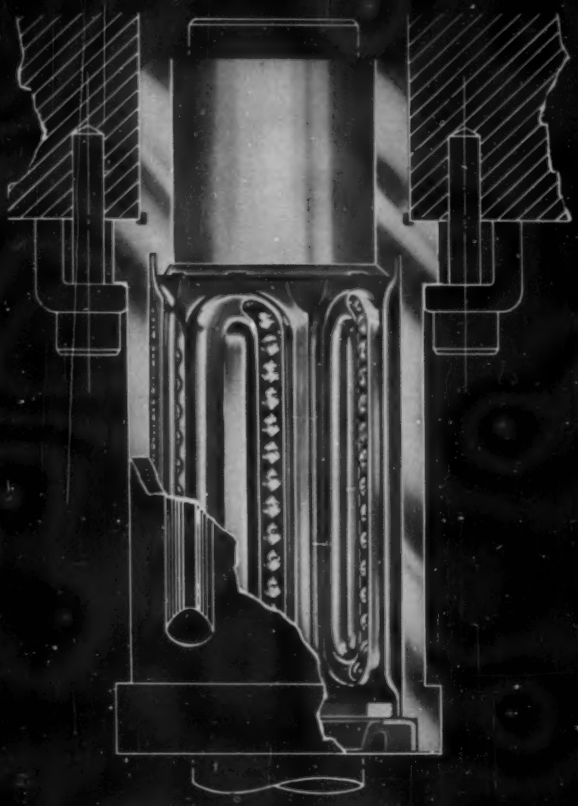
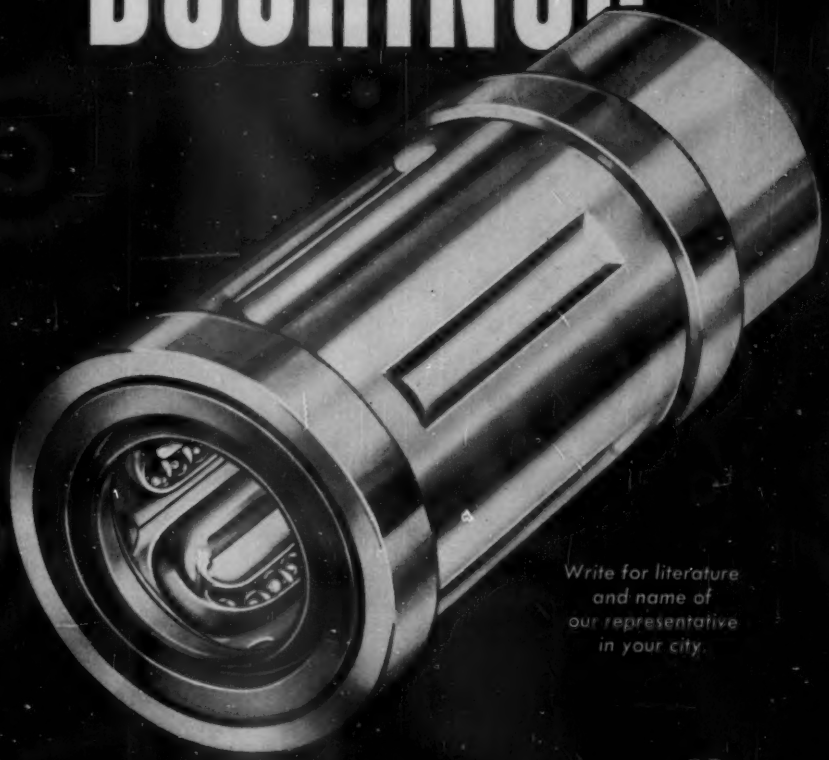


THOMSON INTERCHANGEABLE die-set BALL BUSHINGS®

NEW!



GO ANTI-FRICTION
with a simple bushing replacement
and (1) Improve performance of your *present* dies
and (2) Reduce tool room costs

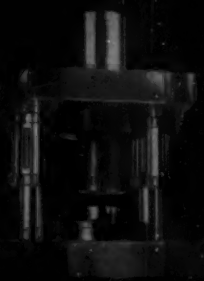
Write for literature and name of our representative in your city.

in the PRESS ROOM

Ball Bushings allow closer fits and maintain alignment which increases die life and permits longer uninterrupted runs. Fewer sharpenings and sustained parts accuracy also result. Periodic lubrication is eliminated and higher speeds are possible. Unlimited travel permits die to be used in any press regardless of stroke. Costly smash-ups due to seizure are eliminated.

in the TOOL ROOM

No cocking and binding . . hence the punch holder "floats" on and off! No time consuming die jacking! Free-rolling *ball* bearings enable the toolmaker to actually "feel in" the fit of mating parts. This saves more time and makes better dies.



THOMSON INDUSTRIES, Inc.
Dept. D2, MANHASSET, NEW YORK

Makers of 60 Case hardened & ground shafting and NYLINED Bearings . . . Sleeve Bearings of DuPont NYLON

DATA
18 units with 64 spindles
60-inch index table
12 work fixtures

Single Kingsbury combines 64 operations

Cuts cost-per-part, space, banks of parts

One machine, 64 operations, 180 parts per hour gross. All this cuts the cost per part. It saves floor space. It reduces banks of parts in process.

A rate of 180 parts per hour gross means a 20-second time cycle or 18.2 seconds for work. To drill the deep holes in this time we used more than one unit, each drilling part depth.

Extra spindles on the vertical units allowed us to use low-cost standard tools instead of special combination tools.

We rebuilt this machine from equipment the customer returned to us. This saved him money, yet he has the regular Kingsbury new-machine guarantee, plus good basic design and rugged, accurate construction. His machine went right back into his production line because our test runs before shipment guaranteed uniform parts that gaged.

If you'd like to save money in drilling type operations, ask us to quote on a job. Kingsbury Machine Tool Corporation, Keene, N. H.

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CAST IRON OIL PUMP HOUSING FOR AUTOMATIC TRANSMISSION

9 Vertical Units with 47 Spindles

DRILL — 22 HOLES
C'SINK — 13 HOLES
TAP — 8 HOLES
REAM — 1 HOLE
END MILL — 1 HOLE & 2 NOTCHES

9 Units with 17 Spindles 12 Downhill

BUTT MILL
DRILL IN STEPS
.344 REAM
4 HOLES

Precision Ground

Atrax SOLID CARBIDE TOOLS AND BURS

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ATRAX LEADS IN ELECTRONICS & SPACE AGE SOLID CARBIDE TOOLING

NEW BROCHURE SHOWS

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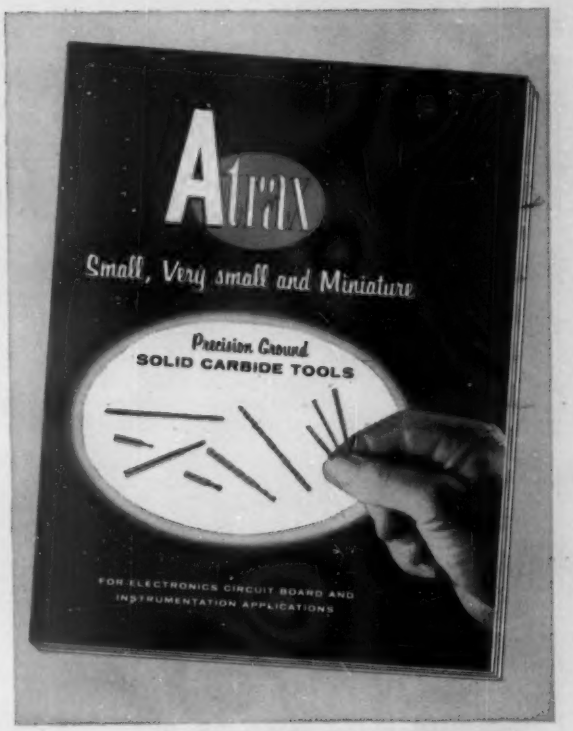
TOOLS FOR ELECTRONICS CIRCUIT BOARD AND INSTRUMENTATION APPLICATIONS

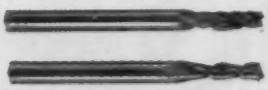


ATRAX MICRO-DRILLS
Wire Sizes #40 through #80.

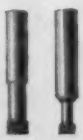
ATRAX DRILL BLANKS
Wire Sizes #40 through #80.

This brochure is available free. It's a guide for selecting and ordering carbide tools for practically any operation on conventional materials as well as abrasive plastics, fibers, synthetics, laminates and exotic materials and alloys.

ATRAX MINIATURE END MILLS
From 1/32" to 1/8" diameter in 2 flute and 4 flute series.



ATRAX MINIATURE STUB ROUTERS
Recommended for routing glass epoxy materials, Fiberglas, phenolics, bakelite, fiber and other synthetic materials.



ATRAX MINIATURE HOLE GRINDING BURS
Hole finishes of 2 micro-inches or better can be expected using these burs.

ATRAX MIDGET BURS
All burs with 3/32" shanks, 1¼" overall.

ATRAX MINIATURE MICRO-REAMERS
In Fractional and Decimal Sizes. Recommended for all materials up to Rockwell C-56.

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It will help you to longer tool life, improved tolerances and greater production on hard-to-cut materials.

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NEWINGTON 11, CONN.

Entirely new grinding possibilities! with the new

CAWI-SPIRAL
Model N 4-90 Z

In one set-up and one operation the pilot and the clearance angle on the new cutting phase is ground. Two-or multistep drills regardless of pilot diameter and pilot length are produced accurately according to specification using gauging device.

CAWI-SPIRAL
Model N 4-90 Z

Starting from standard drills, combination tool with different steps and clearance angles can be produced in one operation. Special dressing devices are available for profiling grinding wheels according to tool form specification.

CAWI-SPIRAL
Model N 4-90 Z

For grinding Ball point drills with or without pilot with additional cutting edges, the necessary radius dressing attachment available. With relief grinding device adjustable relief grinding of pilot possible.

CAWI-SPIRAL
Model N 4-90 Z

Concave and convex radii, intricate forms recesses can be ground. A pantograph controlled profiling attachment has been developed for the dressing of the grinding wheel. In one set-up all cutting edges and clearance angles are ground.

All these new possibilities are offered only with the new

CAWI-SPIRAL
Model N 4-90 Z

Please ask for details and tell us your grinding problems.

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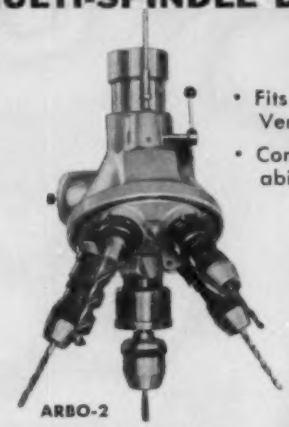
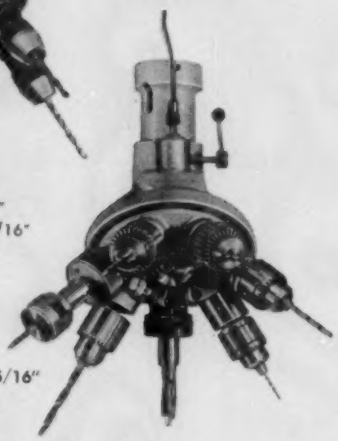
JEMCO Automatic Indexing Turret-Type
MULTI-SPINDLE DRILL HEADS



- Fits any single spindle Vertical Drill Press
- Complete Interchangeability of spindles

ARBO-2
Drilling capacity 0 to 19/32"
Tapping capacity 1/8" to 9/16"
Ten independent spindle speeds
Takes 2 to 7 tools

ARBO-3
Drilling capacity 1/8" to 1"
Tapping capacity 1/4" to 15/16"
Eight independent spindle speeds
Takes 2 to 5 tools



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company _____
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city _____ zone _____ state _____

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WHERE PRECISION IS PARAMOUNT

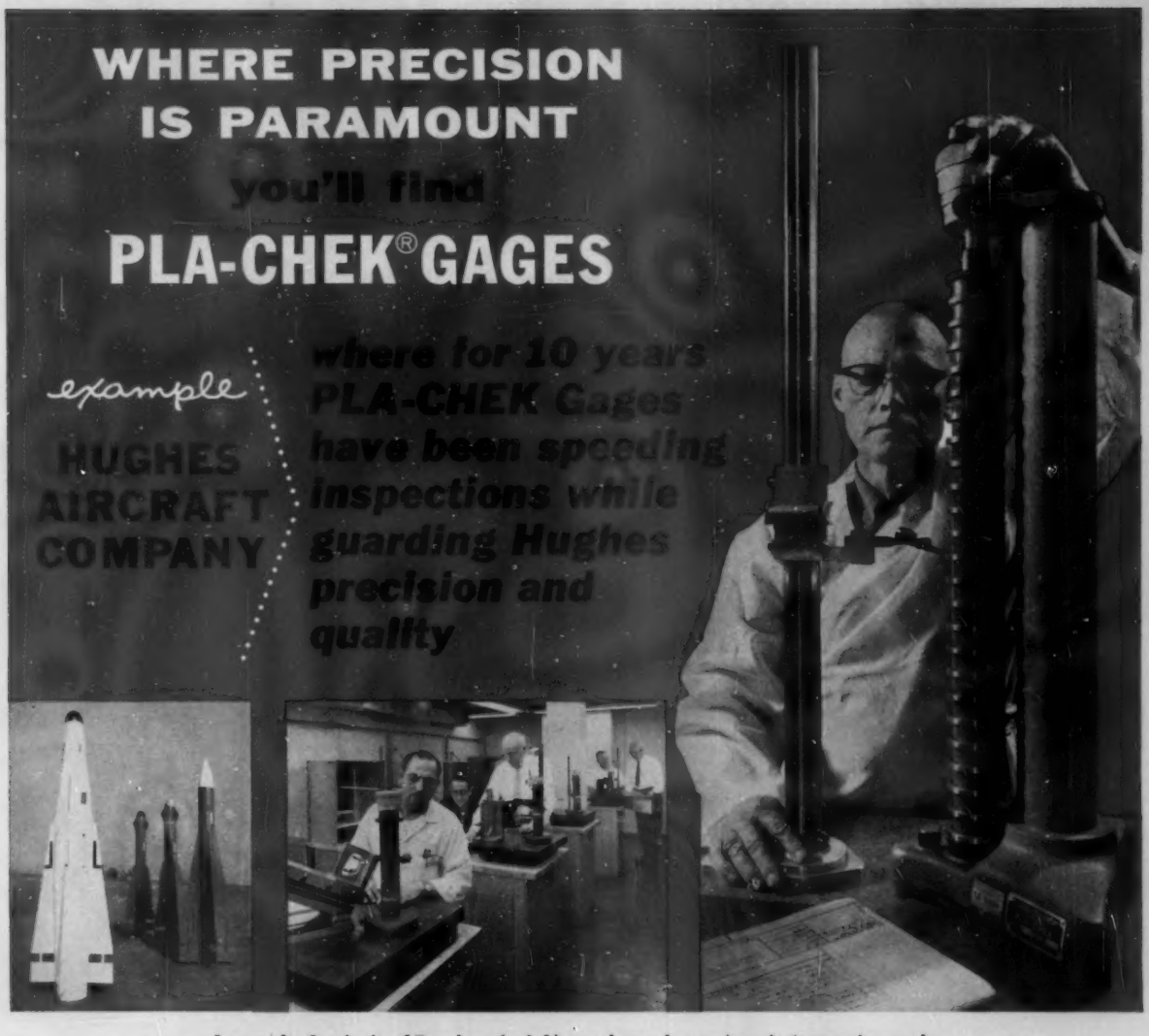
you'll find

PLA-CHEK® GAGES

example

HUGHES AIRCRAFT COMPANY

where for 10 years PLA-CHEK Gages have been speeding inspections while guarding Hughes precision and quality



Just as the Sentinels of Freedom (at left) stand guard over America's security, so do the PLA-CHEK Gages (center) in one Hughes Inspection room guard the precision and quality of these Falcon Missiles, manufactured by Hughes Aircraft Co.

Nowhere will you find precision and accuracy more demanding than in the manufacturing of guided missiles and airborne electronic armament systems. And volume production demands speed. These are reasons why you'll find so many Cadillac PLA-CHEK Gages at work in the plants of Hughes Aircraft Company.

Ten years ago the first PLA-CHEK went to work for Hughes. Today 120 are in daily use speeding inspections and guarding precision at various Hughes' plants. Here's proof of PLA-CHEK performance.

Speedy inspections? Yes! PLA-CHEK Gages can be set 5 to 20 times faster than other methods of comparable accuracy. Precision? Yes! PLA-CHEK Gages are *guaranteed* accurate to .00005″ through the entire range of the 6″, 12″ and 18″ sizes—to .0001″ through the range of the 24″ size. The 36″ and 48″ sizes are *guaranteed* accurate to .0001″ in any 24″ length and to .0002″ over their entire range.

PLA-CHEK Gages are available in a full range of sizes to meet every inspection and layout requirement either at the surface plate or the machine. Let us tell you how you, too, can speed inspections, maintain extreme accuracy, guard the quality of your work and *save money* with PLA-CHEK Gages. Write for complete, detailed literature.

Cadillac GAGE COMPANY

P. O. BOX 3806 • DETROIT 5, MICHIGAN

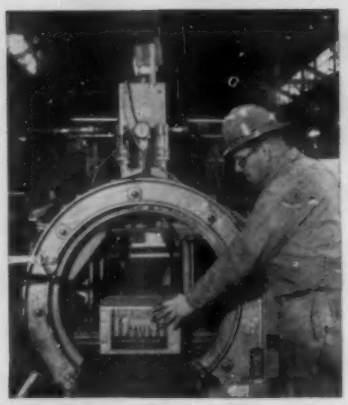
Pullmore Clutches offer

VERSATILE OPERATION

Use any actuation device — air, manual or electric. Rockford Pullmore Clutches start, stop, shift, reverse, inch, cycle and idle. They're used as main drives, auxiliary controls, and power take-offs for thousands of industrial machines. The Dual-Drive Clutches drive forward and reverse, attain high and low speeds, or control as clutch-brake combinations.

. . . FLEXIBLE DESIGN

High-torque compact design fits severe space limitations. Pullmore Clutches are available in single-drive or dual-drive units. The fast but smooth engaging clutches handle torque loads from 126 to 11,000 inch pounds . . . horsepower from 1 to 90 at 500 RPM. Sizes range from 1¾" to 8½" in diameter. Oil or dry operation. Write today for illustrated brochure.

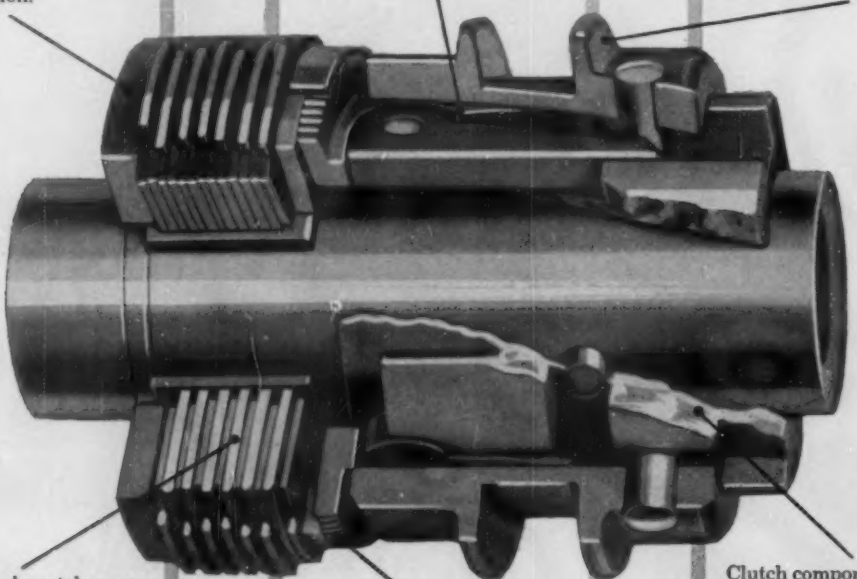


United States Steel Supply Model 12 Automatic Strapping Machine equipped with Rockford Dual-Drive Pullmore Clutch

Symmetrical design and precision machining assure smooth clutch operation. Torque is not affected by centrifugal force or direction of rotation.

Low axial pressure to levers gives positive, instantaneous engagement. High-ratio levers are case hardened forged steel. Immediate disengagement.

Use any actuation device — air, manual or electric. Slight pressure to shifting spool engages clutch. Spool length prevents binding and gives longer life.



Discs meet close tolerance flatness checks. Heat treated steel, graphite-impregnated bronze, sintered bronze or molded discs for oil and dry operation.

Easy Adjustment...simply raise locking spring and turn collar. Adjustment lasts for extra-long periods of heavy-duty service.

Clutch components are precision ground and highly concentric. Locking split ring assures positive axial positioning. Strong construction gives long, rugged clutch service.

ROCKFORD CLUTCH

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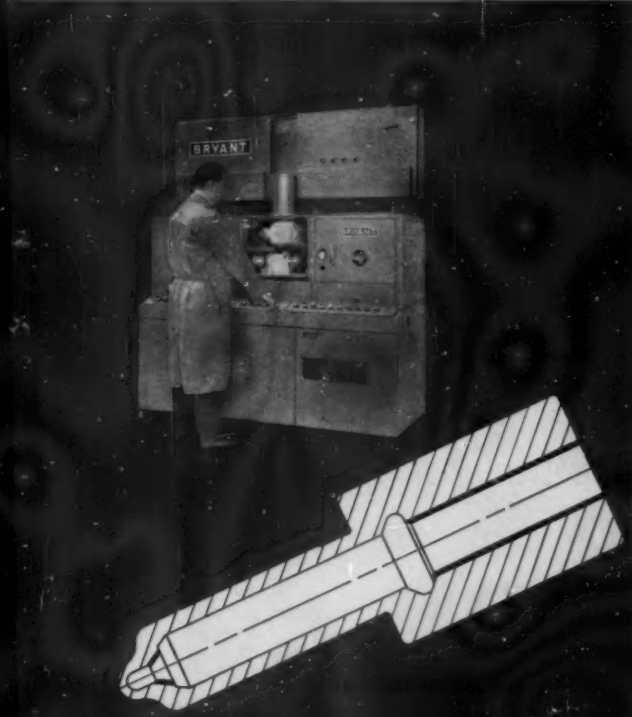
Export Sales Borg-Warner International • 36 So. Wabash, Chicago, Ill.

BW ROCKFORD CLUTCH DIVISION OF BORG-WARNER

CAN YOU TOP THESE 2 GRINDING JOBS?

They're tough. One requires grinding both a straight and a tapered bore in diesel nozzles and similar workpieces at a single chucking. The second requires grinding a wide range of races for miniature and instrument ball bearings. Both are handled efficiently and economically by Bryant high production internal grinders.

All Bryant industry-engineered grinders are proved out by statistical quality control to assure you of predictable day-after-day production quality. Got a tough internal grinding job? Just drop us a line, enclosing specs and production requirements.



SOLUTION to the diesel nozzle job is this new Bryant Double-End Internal Grinder which grinds both a straight and a tapered bore at a single chucking of the workpiece. Two opposed wheel slides and a rotary indexing worktable permit grinding two workpieces simultaneously. Completely automatic, it triples the productivity of conventional machines. And, because this duplex machine cycles automatically, operator simply has to load and unload workparts.

SOLUTION to the grinding of a wide range of miniature and instrument bearing races is the Bryant Model "B" Miniature Centalign® Internal Grinder and its "packaged tooling" for simple, quick job changeover. Available either for ball tracks or for bores, it's the standard machine for miniature bearing production throughout the world. Proved in production lines, it's acknowledged by all major bearing companies as the finest machine available.

BRYANT

Chucking Grinder Co.

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Internal Grinders • Special Machinery

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High Output with **ROUSSELLE**

DOUBLE-CRANK PRESSES

SPEED UP PRODUCTION with these versatile 40-ton presses. Large bed and ram areas make them ideally suited to handle wide rolls or sheets . . . do multiple punching, steel-rule die work and other high output operations. For rapid shockless starting and stopping, presses can be equipped with electrically controlled "Econo-Air" friction clutch . . . Ask for new catalog.

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Mfrs. of Rousselle Presses
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Rousselle Presses are sold exclusively through Leading Machinery Dealers.

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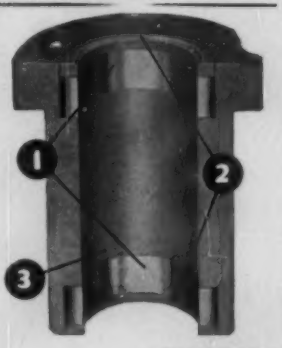
A Cost Saving

BUSHING STORY IN A NUT SHELL



*PATENTED

1. Tungsten carbide rings at the points of wear; **2.** Steel rings protect drills and carbide; **3.** Special hardened alloy steel body; **4.** Performance: same as solid carbide, but need not be handled with kid gloves; **5.** Greatest economy, because of maximum life at minimum cost; **6.** Enjoy the advantages of greater accuracy for a longer time, less spoilage, less machine down-time, added drill and jig life with MEYCO carbide inserted drill jig bushings.

Write for New Bushing Catalog No. 42

MEYCO **W. F. MEYERS CO., Inc.**
BEDFORD, INDIANA
A famous name in precision tools since 1888

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MAGNETS

FOR HUNDREDS OF USES TO CUT PRODUCTION COSTS AND INCREASE EFFICIENCY

Permanent Alnico Magnets will hold steel parts thru' every stage of production . . . on conveyor lines, in tanks and paint booths . . . as holders in various machining operations, as sheet steel separators and as devices for retrieving parts or cleaning up metal shavings, etc.

There are hundreds of money saving uses for Empire Permanent Magnets and your first cost is the last cost.

WRITE FOR NEW CATALOG AND MONEY SAVING MAGNET IDEAS

EMPIRE MAGNETICS INC.

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Announcing . . .

ASTME 1962 ENGINEERING CONFERENCE and EXPOSITION

CLEVELAND MAY 7-11, 1962

For Exhibits, write **L. ABRAMS**
Exposition Manager

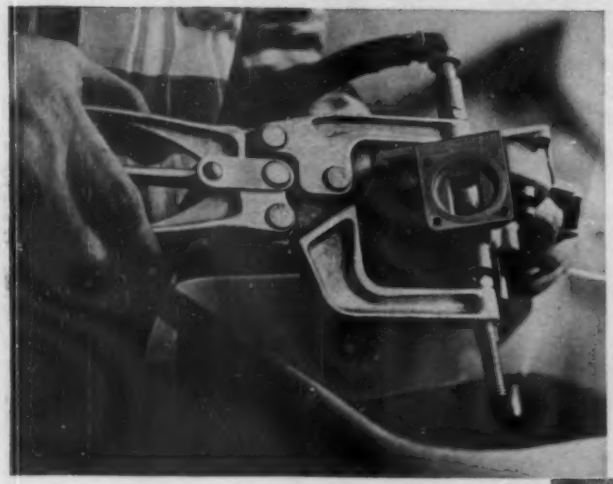
For Program, write **GILBERT SEELEY**
Program Director

ASTME 10700 Puritan Ave., Detroit 38

What does "Blanchard Ground" mean? Well, a glance at this sample case would show that it means finishes as fine as 2 microns. And a quick check with the optical flat below would show flatness to within 1 light band. What's more, Blanchards provide high precision, high production grinding of materials ranging from glass and stone, thru gems and plastics, as well as ferrous and non-ferrous metals. Equally efficient at hogging, too. Send for "The Art of Blanchard Surface Grinding" and get the whole story.
BLANCHARD GROUND
2MU
4MU
8MU
15MU
20MU
30MU
PUT IT ON THE BLANCHARD

THE BLANCHARD MACHINE COMPANY 64 State Street, Cambridge 39, Massachusetts

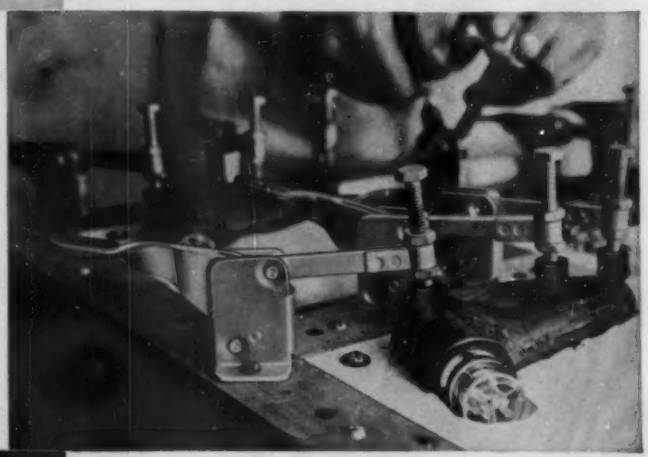
Look what clamps are doing!



Practical uses of Wespo Toggle Clamps and Pliers that may suggest ways you can save

Toggle plier serves as low cost fixture for testing castings The air line is connected through one jaw of a Wespo Model 522 Toggle Plier. The plier is then clamped onto the casting and air applied by a foot control. Immersing the casting into a tank quickly spots any defects. Patented "Quick trigger" feature of the Model 522 instantly releases the casting; speeds testing. Rugged, lightweight Wespo toggle pliers are available in various jaw capacities and sizes.

Holding these glued parts together while drying is a simple task with Wespo Horizontal Bar-Type Toggle Clamps. Neoprene-capped spindles prevent damage to plastic surfaces, yet securely hold the parts during the drying operations. Wespo toggle clamps are available in more than 80 types and sizes. So, the next time you think clamps, think Wespo!



Simple, low cost "parking brake" for this track-operated frame is provided by a Wespo Push-Pull Clamp equipped with a neoprene-capped spindle. "Brake" is quickly applied or released by a simple flick of the wrist. Wespo Push-Pull Clamps are available in various sizes and holding pressures and are ordinarily used on holding fixtures where push or pull clamping is required.

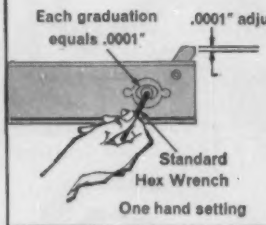
FREE CLAMP CATALOG!
Ask your Wespo distributor for your free copy of this 16-page Wespo catalog. It will help you quickly select the right clamp for every clamping job.

WESPO

DIVISION OF VLIER ENGINEERING CORPORATION
26935 W. Seven Mile Rd., Detroit 19, Michigan
Formerly West Point Manufacturing Company

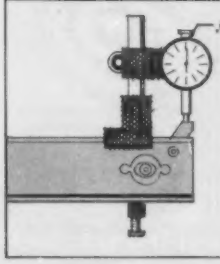
HOW TO IMPROVE MACHINING ACCURACY AND REDUCE TOOLSETTING TIME

DAVIS "SUPER-MIKE" TOOLS



TO SET

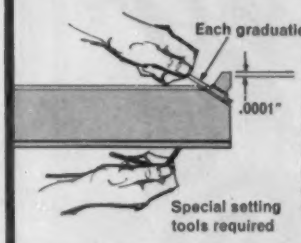
Operator or toolsetter simply adjusts the cutter the desired amount as indicated on the tool's direct-reading micrometer dial screw. The micrometer is accurate to .0001". Cutter lock screw remains locked throughout setting operation.



READY TO CUT

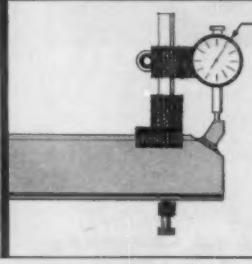
Because the lock screw is not disturbed during cutter setting, backlash or "growth" due to clamping is eliminated. An indicator check shows cutter set out accurately to .0001". Cutter is now ready for machining operation.

OTHER MICROMETER-ADJUSTABLE TOOLS



TO SET

Operator or toolsetter must first loosen cutter locking screw, then move the cutter out to desired position. Setting accuracies greater than .001" graduation on micrometer dial require use of special setting gage.

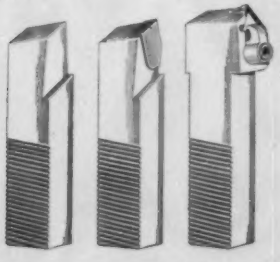


LOCK, RECHECK RESET

After cutter is set, it must be clamped by tightening down loosened lock screw. During clamping, backlash can result, requiring rechecking. Where extreme accuracies are required, setting, checking, and resetting process may have to be repeated several times.

HOW IT WORKS

Serrations on one side of the cutter engage with matching serrations on the expanding plunger. The plunger is threaded to the micrometer adjusting screw, moving up and down as the screw is turned to move the cutter in or out. High leverage makes it possible to adjust the cutter without loosening the lock screw.



These three cutters are completely interchangeable on any "Super-Mike" unit.

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Standard "Super-Mike" flycutter tools are available for machining holes from 1¼" to 9". These tools are included in Davis "Super-Mike" stub boring tool sets, which also contain continuous-feed heads, boring bars, adapter sleeves, and the most commonly used setup accessories.

For complete information on Davis "Super-Mike" micrometer-adjustable flycutter tooling, write or telephone your nearest Davis distributor, or write for catalog D-520-A.

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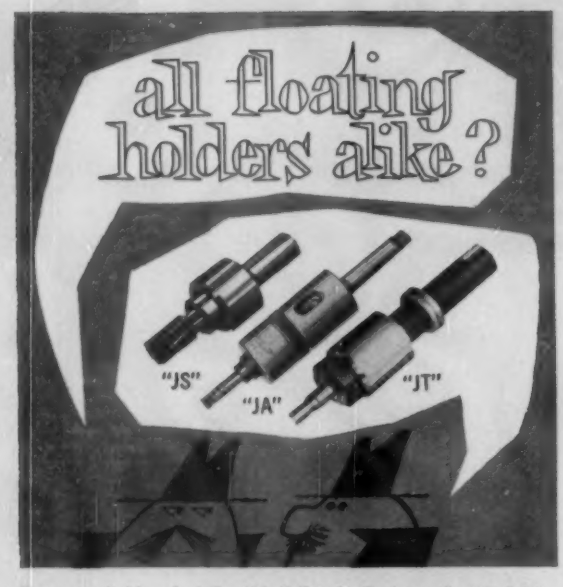
D61-9



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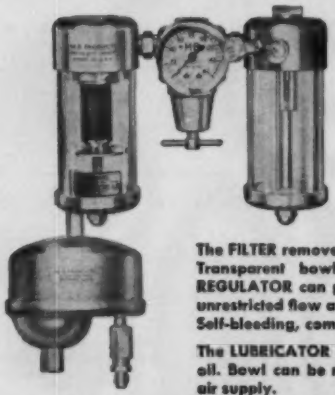

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64	Manufacturing with Space Age Materials	Oct. 10-11, 1961	Philadelphia, Pa. Sheraton Hotel
65	Prototype and Short Run Tooling Methods	Nov. 8-9, 1961	New York, N. Y. Belmont Plaza Hotel
66	Electric Machining and Forming (Electro Metal Removal)	Dec. 6-7, 1961	Hartford, Conn. Statler Hilton Hotel
67	Prototype and Short Run Tooling Methods	Jan. 23-24, 1962	Charlotte, N. C. Barringer Hotel
68	Die Design and Press Tooling	Feb. 7-8, 1962	Hartford, Conn. Statler Hilton Hotel
69	Automatic Production-Numerical Control	Feb. 27-28, 1962	Cleveland, Ohio Statler Hilton Hotel
70	Prototype and Short Run Tooling Methods	Mar. 7-8, 1962	Dallas, Texas Statler Hilton Hotel
71	Carbide and Ceramic Tooling	Mar. 28-29, 1962	Chicago, Ill. Conrad Hilton Hotel
72	High Energy Rate Forming	Apr. 11-12, 1962	Denver, Col. Brown Palace Hotel
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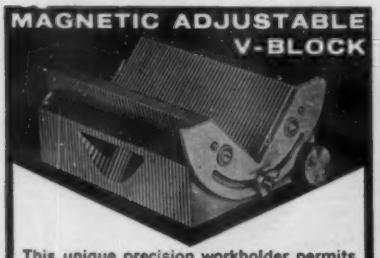

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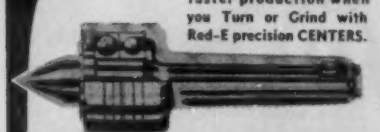

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August 1961

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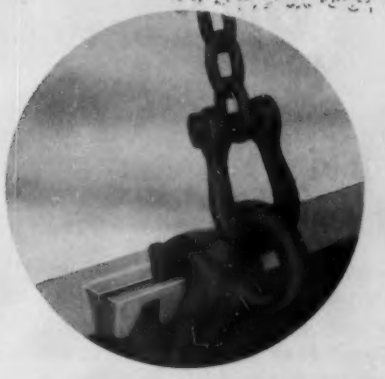

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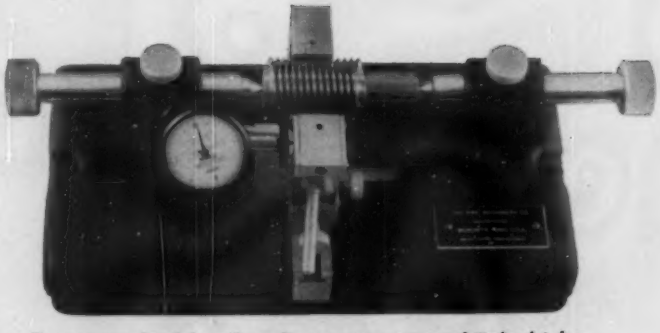

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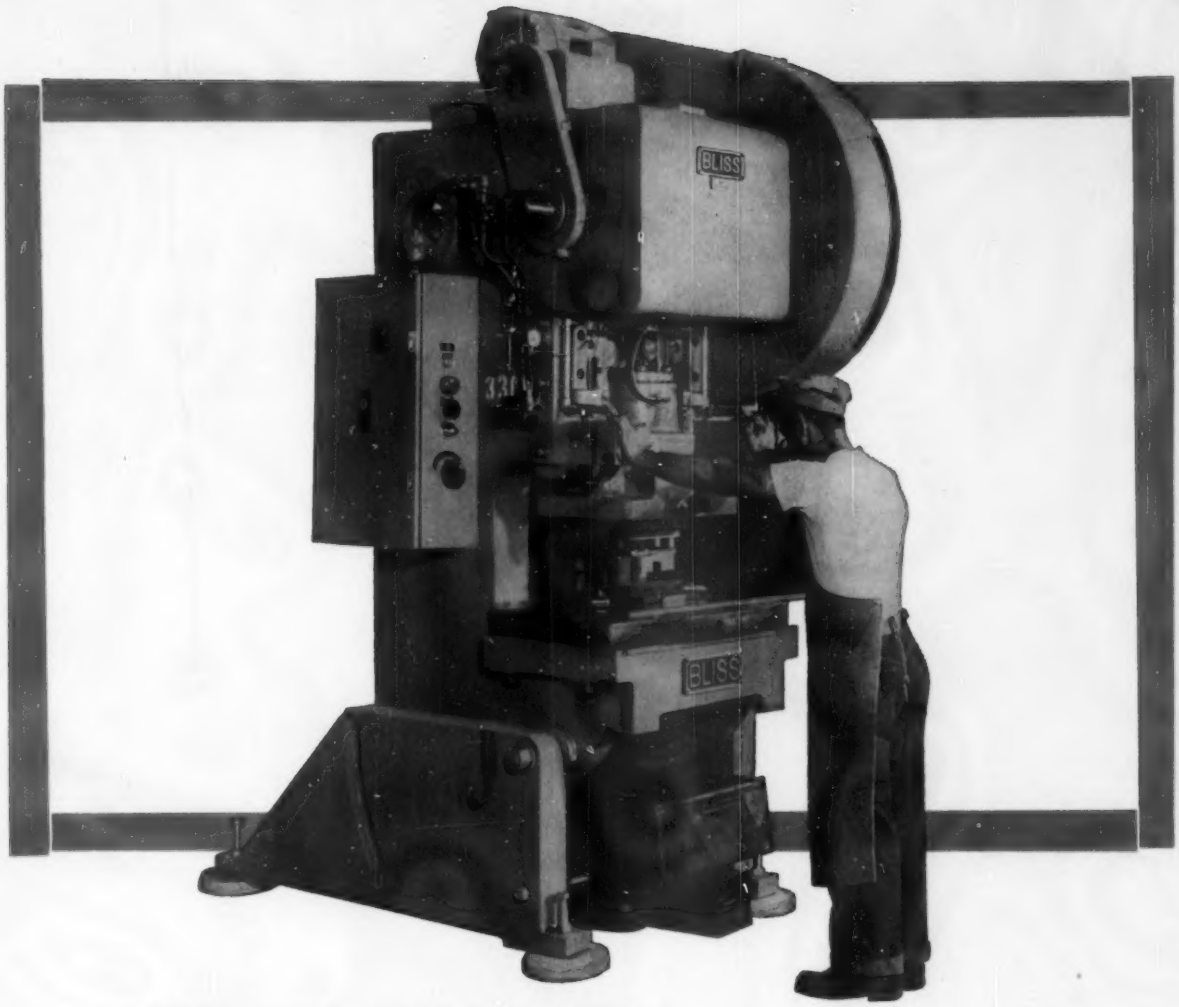

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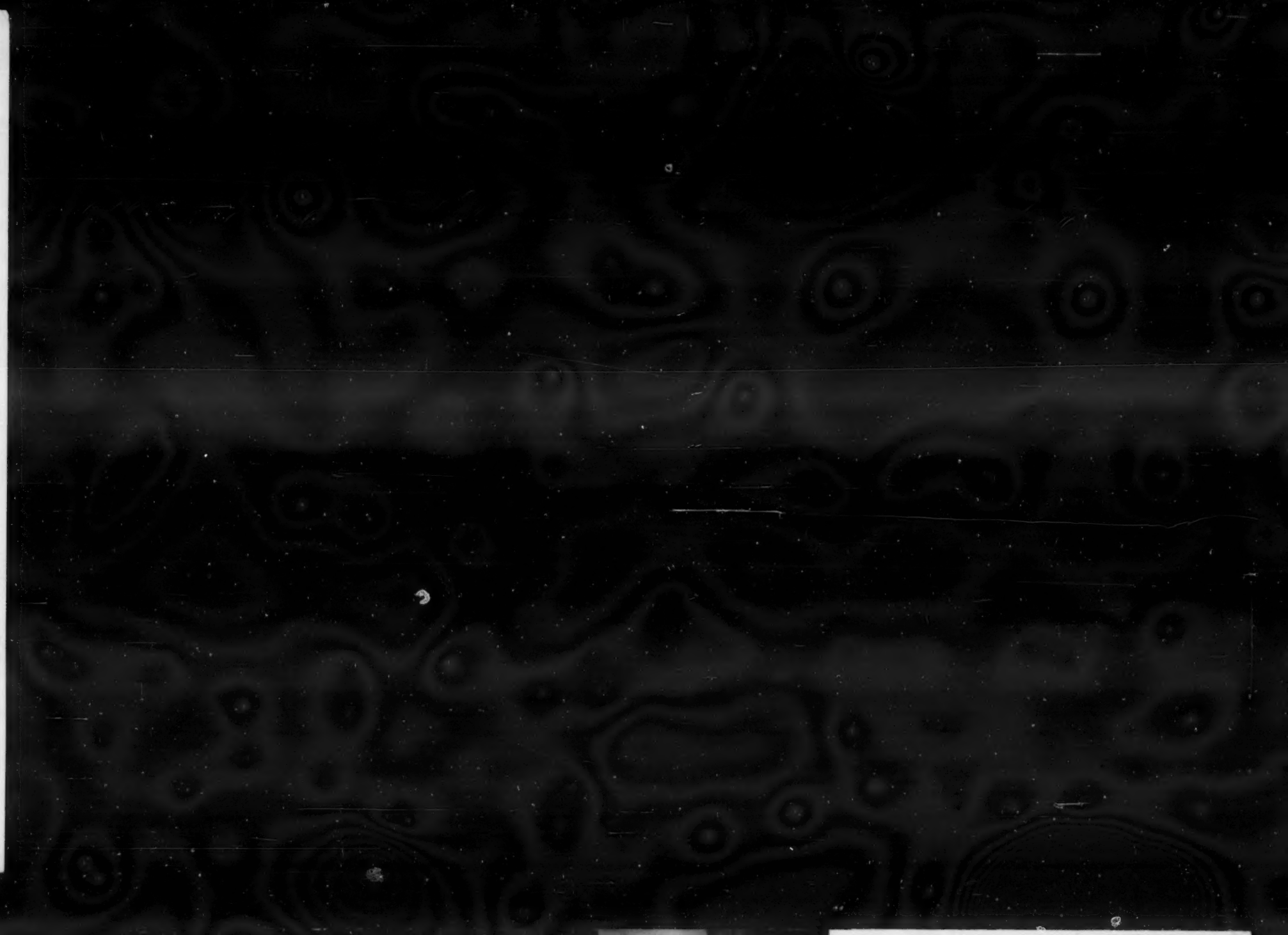
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